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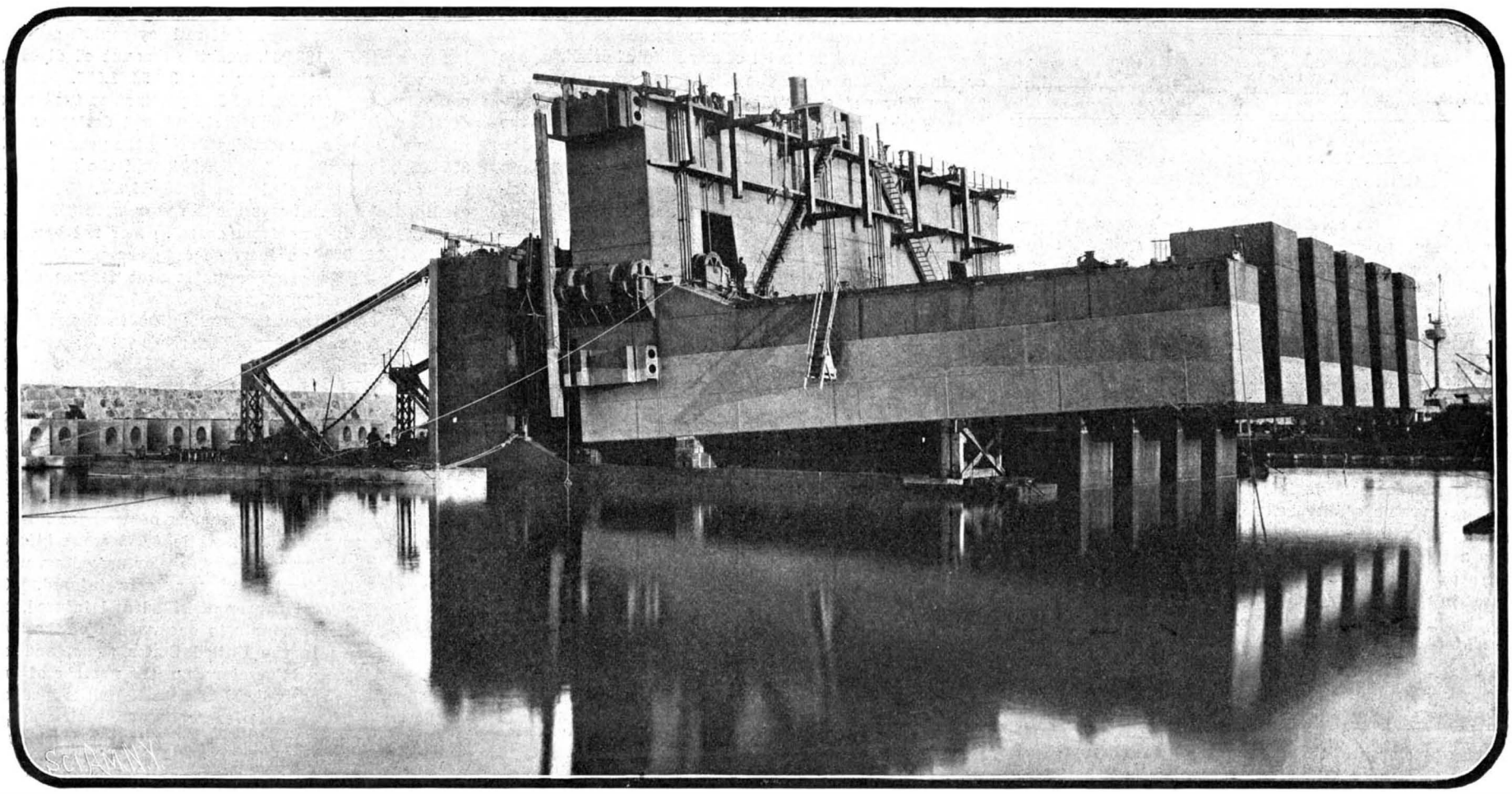
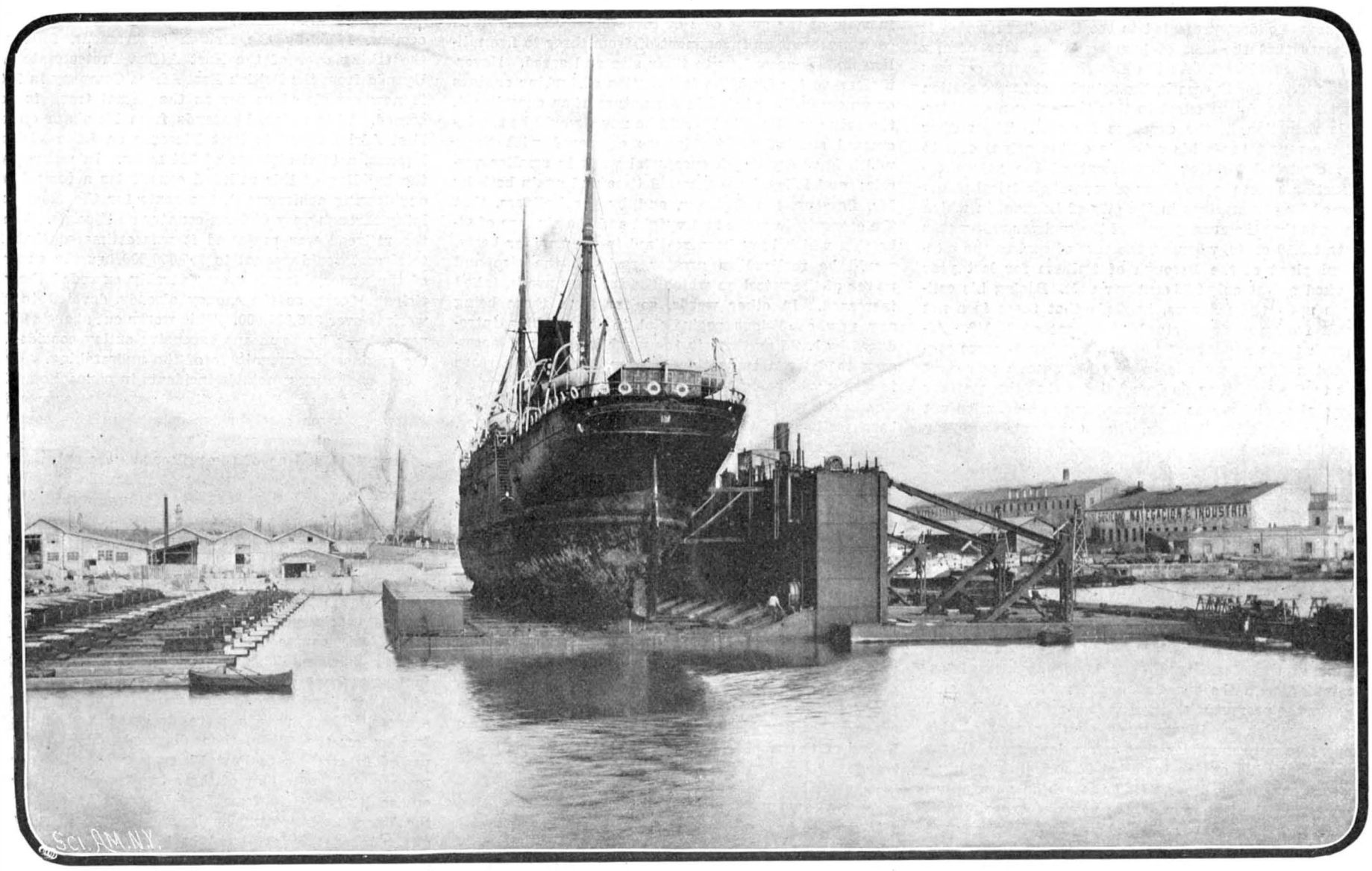


Pontoon Dock Clear of the Water for Painting, Showing Its Self-Lifting Capacity.



Ship Raised on Pontoon, Ready for Transference to Gridiron to the Left.

A 6,000-TON FLOATING DEPOSITING PONTOON DOCK.—[See page 29.]

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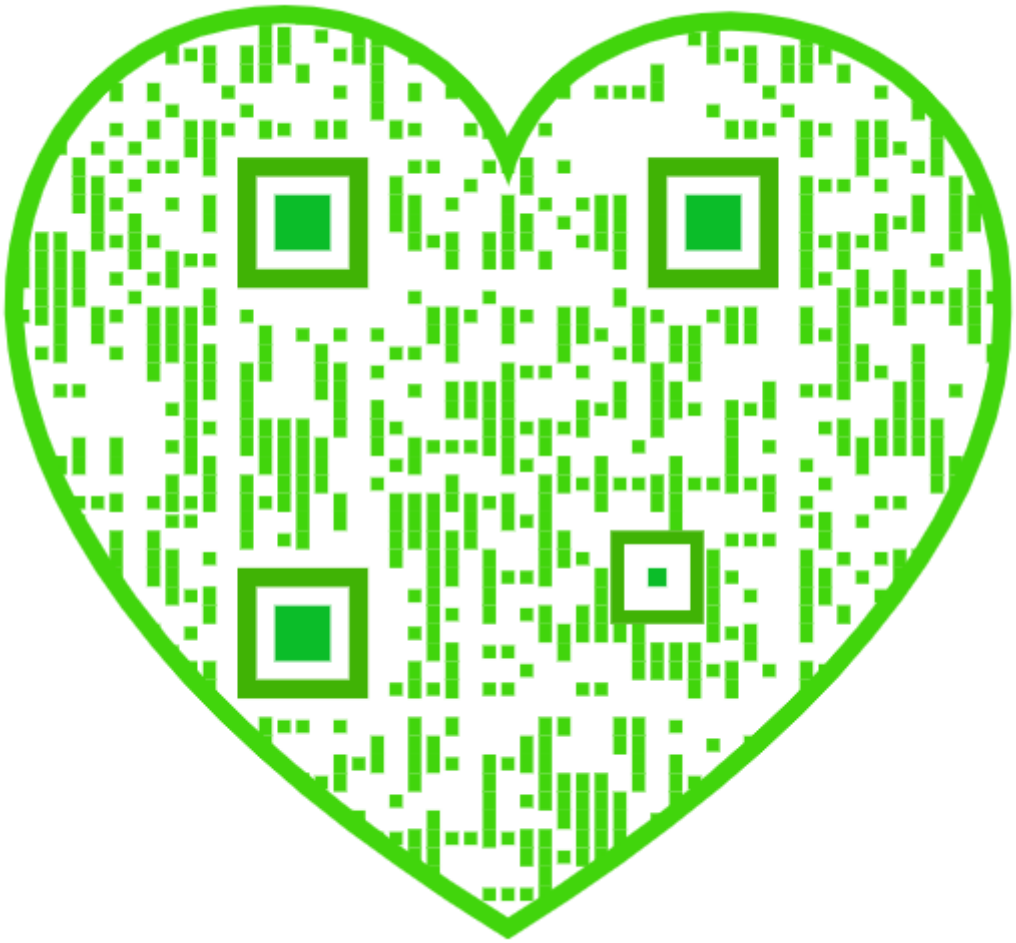

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MUNN & CO., 361 Broadway, New York.

NEW YORK, SATURDAY, JULY 11, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

DESTRUCTION OF CITY REFUSE.

The question of the destruction of city refuse by burning and the utilization of the heat for power—a question that has attracted considerable attention and has been put to careful test in the older countries—is destined to receive widespread attention from the municipal authorities in America. Many years ago attention was drawn to the possibility of a city getting rid of its refuse by a method that would yield a valuable return, by the Borough Engineer of Southampton, England, who utilized the waste heat from a refuse destructor in driving the electrical plant for lighting the city. Since that time the world has been made familiar with the results obtained in one of the London districts, and a large amount of valuable matter has been written and data gathered upon this most important subject. It is now pretty well established that the value of city refuse as fuel for city lighting will vary with the locality and the general conditions. As a rule, it has been found that in England the destruction of refuse does not alone furnish sufficient heat to run the city lighting plant, and recourse has had to be made to the coal pile. When the duty to be performed is entirely that of electric lighting, the refuse destructor has not given such good results as when the plant was used for operating a street railway system. It has been found that the refuse destructor gives its best results when it is working at an even rate of combustion, and this condition is obtained where the load on the electric plant is not subject to extreme fluctuations.

Valuable information in connection with the working of the refuse destructor, when employed in raising steam for an electric plant, is furnished in a recent report by the Electrical Engineer of the Borough of Fulham, London, presented to the Council, in which it appears that the cost of burning 30,201 tons of city refuse was $27,100. As the electrical department was paid $19,230 for the work, the actual cost to the station was $7,870. As an offset to this there was a considerable reduction in the expenses for coal. The author of the report bases his estimate of the actual cost to the electrical lighting department of the refuse destruction, upon the workings of several electrical plants owned by corporations in the city of London, in which he finds that the average cost of the coal per unit works out at 2.10 cents, whereas, the cost of coal to the electrical plant of the Borough of Fulham for last year worked out at only 0.76 cent per unit. Basing his estimate upon these figures, he finds that there is a net profit from the destructor department of $3,442. Although these results are not so flattering as were predicted a few years ago, when this system was first put to the test, they do demonstrate that the sanitary disposal of city refuse by cremating can be carried out with a net profit to the user, where the plant is properly installed and the general conditions are favorable. The results, as we have said, will be largely modified by local conditions; and it is a question of vital interest to the great cities on this side of the Atlantic, as to how far this method of refuse disposal, which has every sanitary consideration to recommend it, can be carried out with similar economic results to those obtained in the plant under consideration.

THE STEAM TURBINE FOR OCEAN SERVICE.

The unbroken success which has attended the application of the steam turbine to steamship propulsion, beginning with the experimental "Turbinia," and ending for the present with the handsome 22-knot Channel steamer which we illustrate on another page of this issue, is a sure guaranty that before long we shall see this remarkable engine installed in a first-class, high-speed transatlantic liner. Had there been any failure recorded in the last four or five years of experimental work; had the steam turbine shown any inherent and unsurmountable defect rendering it unsuitable for marine purposes, the great steamship companies would be justified in their hesitation to substitute the compact and self-balanced motor for the ponderous and at best but poorly balanced reciprocating engine. But no such obstacle has shown itself. It is true, the impossibility of reversing the turbine seemed for a while to be fatal to its introduction on steamships; but the present arrangement of installing a set of reversing turbines on the same shaft with the main engine has removed the difficulty, and the distribution of the motive power upon three shafts has provided all maneuvering power that can reasonably be asked for. A recapitulation of the experimental period referred to will show how unbroken the success of the marine turbine has been. The very first vessel to carry it, the "Turbinia," broke all existing records for speed, steaming at over 34 knots an hour. Then came the "Viper" and the "Cobra," whose turbine engines placed them so far ahead of all existing torpedo boats in point of speed as to put them in a class by themselves, the 37 knots achieved by the former boat never having been surpassed in an official and properly certified trial of any kind of vessel before or since. Then came the Clyde passenger steamers "King Edward" and "Alexandra," in which the conditions for comparative tests were most excellent, the boats being of about the same size and engaged in the same service as existing high-class vessels, the data of whose performance was well known to the companies who owned them. In these vessels it was proved that on a given displacement and coal consumption, it was possible to get about a knot extra speed by the use of the turbine motor, while the absence of vibration and the increased passenger accommodation were further distinct and very valuable gains in favor of the new boats. Quietness in running, economy in space and fuel are features which naturally attracted the attention of the yachting world, and to-day three Americans are owners of vessels which are among the fastest and most comfortable yachts afloat. "Tarantula," with a speed of 26 knots, and "Emerald" and "Lorena," with speeds respectively of 16 and 18 knots an hour, will probably be seen in these waters during the coming international cup races, where they will meet another successful turbine yacht in the "Resolution," which is driven by a turbine engine of a purely American design. The latest success is that achieved in the turbine steamer "Queen," recently put in service between Calais and Dover, which made her first cross-Channel trip at an average speed of 22 knots an hour. She is to be followed by other vessels of this type, which are now building for three different companies that ply across the stormy waters around Great Britain.

As a matter of fact, in view of the unbroken success that has attended the use of the turbine in the smaller classes of steamship, the hesitation of the large transportation companies to adopt this system for the big liners is to be attributed to a conservatism which, although it is not justified by the facts, is not unnatural in view of the great cost of these huge vessels, which each represent an investment of from three to five million dollars according to their size and speed. Nevertheless, so far from the installation of turbine engines on an ocean liner being in the nature of an experiment, the only condition that would be novel would be the increased size of the turbine as compared with those which have done such successful work in smaller vessels; and it has been asserted time and again both by Mr. Parsons, the designer, and by the builders, that the economy in space and weight and the absence of vibration which have been realized in the smaller boats, would be realized in greater ratio as the size and power of the vessel on which the turbines are installed increased. In other words, so far from there being any new conditions prejudicial to the turbine introduced by building them in the much larger units necessary to drive a transatlantic liner, the very increase in size would bring about a larger proportionate reduction in the weight and space per unit of power than has been realized in the vessels of 2,000 tons and under, that are now running successfully with turbine engines. Basing their calculations upon data already secured, it is estimated by the builders that in a vessel of the same displacement as the largest and fastest of the present transatlantic steamers, it would be possible, by the installation of turbine engines, to secure fully one knot more speed; and when we remember that the resistance of these fast vessels increases as something more than the cube of the speed, it will be seen how great would be the actual economy of a large capacity marine engine. Furthermore, from the passengers' point of view, there will be a great gain in comfort due to the absence of vibration; for it cannot be denied that the extreme vibration of the high-speed ocean liners of to-day, due to the reciprocating engine, is one of the most serious drawbacks of transatlantic travel.

GROWTH OF OUR RAILROAD SYSTEM.

It was to be expected that the present commercial prosperity would have a marked effect upon the railroad system of the United States, and the statistics for the last fiscal year of the Interstate Commerce Commission show that in every respect there has been a decided and very satisfactory growth. The total single-track railway mileage is 202,472 miles, an increase for the year of 5,234 miles, which is greater than that for any other year since 1890. For the service of the 2,037 railway corporations included in this estimate, 41,228 locomotives were required. The total number of cars of all classes in use at the close of the year was 1,640,220, an increase of over 89,000 over the previous year. Of this total number, 36,991 were passenger cars, 1,546,132 freight cars, and 57,097 were devoted to the direct service of the railways.

It is gratifying to learn that of the total number of freight cars as given above, 1,204,929 were fitted with train brakes and 1,521,000 with automatic couplers. The total number of employes at the close of last year was 1,189,315, an increase of 118,146. There was paid out during the year in salaries and wages $676,028,592. The amount of railway capital outstanding was $12,134,182,964, and the amount of dividends declared during the year was $185,391,655. This is equivalent to a dividend of 5.55 per cent on the amount of stock on which some dividend was declared. The number of pasengers carried during the year was 649,878,505, an increase of 42,600,384, and the number of tons of freight carried was 1,200,315,787. The gross earnings of the railways for the year were $1,726,380,267, and the income from operation, or net earnings, was $610,131,520, an increase over the previous year of over $52,000,000. The unpleasant feature of the statistics is reached when we consider the record of railway accidents for the year. The total number of casualties for the twelve months was 73,250; the number of persons killed having been 8,588, and the number injured 64,662. Of these totals, nearly 3,000 railroad employes were killed and over 50,000 were injured—truly a ghastly result; one that should bring a blush to the cheek of every patriotic American. It certainly looks as though the charge often laid against us, that we are brutally indifferent to the sanctity of human life, is only too true. The number of passengers killed during the year was 345, while 6,683 were injured. This is a great increase over the year preceding, when 283 were killed and 4,988 pasengers injured. Referring to the total figures of killed and injured, the number of killed amounts to one-seventh of the total number of men in the United States army, and the number of injured is greater than the number of men in the army by nearly 5,000. As for the risks incurred by the trainmen on American railroads, their work is certainly the most perilous of any in the world, not even excluding that of the soldier in time of warfare; for our railroads kill in a single twelvemonth one employe out of every 135, and they injure one out of every ten.

PROGRESS OF THE UGANDA RAILROAD.

The Uganda Railroad, which was commenced in December, 1895, by the British government, following the taking over of the East Africa Protectorate and Uganda from the British East Africa Company in 1894, is now completed so far as the actual track is concerned. This railroad extends from Mombasa on the East Africa Coast to Port Florence on Lake Victoria Nyanza, a total distance of 584 miles. In many ways the building of this railroad constitutes a remarkable engineering achievement, the route for the most part lying through very difficult country and jungle. When the railroad was projected it was estimated that its total cost would amount to $15,000,000, but the expense of the undertaking has considerably exceeded the anticipated cost, as the money already devoted to the work is over $25,000,000. This works out about $43,000 per mile—a by no means expensive outlay considering the engineering magnitude of the undertaking.

One of the most notable incidents in connection with the construction of this railroad was the large order of twenty-seven steel bridges placed in this country. These have all been erected and finished and the only uncompleted section of the railroad is the substitution of steel bridges for a number of insignificant temporary wooden structures.

Already the railroad is exercising a beneficial influence upon the country through which it passes, while the maritime traffic upon the Victoria Nyanza is being rapidly developed. Both Indians, Italians, and Germans have large vessels trading upon the lake. A twin-screw steamer is already in service and a sister vessel is in course of erection at Port Florence for a similar purpose. The vessels each measure 176 feet in length, have a draft of 6 feet, and a displacement of 600 tons, and passenger accommodation for 100 passengers. These vessels were designed and built at Paisley on the Clyde, then dismembered and transported in sections to Port Florence, where they were reassembled. The first of these two twin-screw steamers on its trial trip from Port Florence to Entebbe—the Uganda administration headquarters on the opposite side of the lake—and back again occupied two days, including time for discharging cargo at Entebbe.

At present a through train runs twice a week each way between Mombasa and Port Florence, and the new

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steamers run across the lake in connection with the up and down trains as traffic demands. According to the official statement the returns amount to $15 per mile per week or roughly $9,000 weekly for the entire line. It is stated that the working of the railway will represent a saving to the Uganda and East Africa Protectorates of $175,000 per annum in transport expenses.

The work of surveying the German portions of the Victoria Nyanza is also well advanced. The whole of the British portion is already mapped out, and it is anticipated that the German survey will occupy at least another year. A vast expanse of new country will be opened up, and new tribes visited.

NICKEL-STEEL.

BY CRITTENDEN MARRIOTT.

The public has heard of nickel-steel chiefly, if not solely, as a material for making armor plate of unprecedented hardness and toughness; the engineer has heard of it as also possessing greater strength and elasticity than ordinary steel, and as therefore enabling lighter machinery to be used to do the same work; but only a few scientists are as yet familiar with its most important quality of all—that of being (when combined in certain proportions) nearly if not quite exempt from expansion and contraction through heat and cold.

It is almost impossible to grasp at once the full significance of this far-reaching exemption. Every other substance in the world varies in volume with every degree of change in temperature, by an amount known as the "coefficient of expansion" of that substance—an amount supposedly constant within ordinary limits of temperature. Within these limits, brass has a coefficient of about .000018 (that is, it increases by eighteen-millionths of its length for every degree Centigrade by which its temperature is raised); steel has a coefficient of about .000011; nickel of .000013; silver of .000019; platinum, least expansible of all ordinary metals, of .000009. But a combination of 36 parts of nickel with 64 parts of steel has a coefficient of only .000001. The alloy with this low expansion is already made commercially, though on a small scale, and its inventor, Charles Edward Guillaume, of the International Bureau of Standards, a distinguished French scientist, asserts that it can be made with no coefficient of expansion at all.

The importance of what has been attained already is clear when it is said that there is probably no single cause in tool making, machine work, and construction of every sort, that gives so much trouble to the engineer as does the phenomenon of expansion and contraction on account of changes of temperature. To allow for it requires complicated calculations, difficult mechanical adaptations, and much expense. Bridges must be built with one end, at least, free to move; rails must be laid so as to allow some "play" when the weather changes; watches and clocks must be fitted with compensating balances or pendulums if they are to run true in both hot and cold weather. In problems of exact linear measurement, the temperature of the measuring tape or rod must be allowed for if correct results are to be attained; a surveyor's tape will vary quite enough between winter and summer to cause a law suit unless the proper correction is made; even the mere heat of the hand may set at fault the delicate measurements of the micrometer calipers for noting the thread of tiny screws and the like. When two metals, or two pieces of one metal, come in contact, their unequal expansion may prove ruinous; a great steel building may tear itself to pieces within a few years unless some movement of its parts is allowed; a "hot box" may stop a train for hours, not because the axle is hot, but because it is hotter than the journal in which it works and the two bind in consequence; no screw of one metal can be sunk in another having a very different coefficient without either breaking its own threads or cracking the other at the first marked change of temperature. Obviously, any discovery of a metallic alloy that is reasonably cheap, and that either does not alter at all or alters much less than any substance in common use, is of tremendous import to the mechanical world, even if it has no other good qualities to recommend it. But nickel steel, made with more than 25 per cent of nickel, has many other good qualities. Not only has it, in certain proportions, less than one ninth the expansive coefficient of platinum, but it also takes a high polish, is elastic, very difficult to rust, and though hard, is yet easily worked with the file or the lathe.

The discovery of these good qualities was not made by chance, nor was it due wholly to one man, although one man has brought them to the point of practicality. The key note of the whole lay in certain curious phenomena relating to magnetism, first noticed some ten years ago, which drew attention to the alloys and led to the discovery that an alloy of 22 per cent of nickel and 3 per cent of chrome with 75 per cent of steel had only half the coefficient of expansion of brass. In 1896, M. Guillaume found that a 30 per cent alloy had a less coefficient than platinum. This led him to investigate the whole subject.

As the magnetic qualities of the alloys presented some startling contradictions to general laws, it was to these that he first turned his attention. He found, broadly speaking, that alloys with less than 25 per cent of nickel can be rendered either non-magnetic or be given a degree of magnetism which they will retain without regard to their temperature; that alloys containing between 25 and 35 per cent of nickel have a magnetism that varies with the temperature; and that alloys of more than 35 per cent of nickel remain permanently magnetic at their maximum capacity for all ordinary climatic temperatures.

Alloys under 25 per cent will be of great use in several ways, but they are useless for the purpose under discussion, as they have high coefficients of expansion. Those over 25 per cent, however, are of great use. As their magnetism at ordinary temperatures increases, so also their hardness and elasticity increase and their expansion coefficients decrease, until at a little more than 36 per cent, when they are perfectly magnetic, this coefficient sinks to .000001, the lowest known.

The first hint of this remarkable quality was made public by M. Guillaume in an article in a French scientific paper in 1899, but the matter was not set forth in its entirety until the meeting of the International Geodetic Society at Paris last fall. It seems to have escaped the attention of the American press, the first extended news of it having been brought to this country by Mr. Isaac Winston, of the United States Coast and Geodetic Survey, who was a delegate to the meeting of the Association.

The first attempt to take advantage of it in this country is due to Mr. E. G. Fischer, also of the Survey, who conceived the idea that this non-expansible alloy would be very valuable in constructing surveying levels, which are always more or less damaged by the expansion and contraction of their working parts due to the changes of temperature to which they are subjected. Parts that fit closely at first, soon become loose and cause no end of trouble by giving rise to inaccurate observations. Inquiry showed, however, that it was not possible at that time to get the tubes and castings needed from France, and, there being no steel foundry at hand, Mr. Fischer, as chief of the Instrument Division of the Survey, engaged a brass founder to make for him some nickel iron. The comparatively low temperatures which alone could be obtained, caused the first experiments (which were made with ordinary machinery steel and with steel filings) to give impure mechanical results, although the coefficient obtained was as low as .000003. Cast iron was then tried, and as much less heat was required with this, excellent mechanical results were obtained; the coefficient, however, had risen to .000005. So a fourth attempt was made altering the percentage of nickel from 36 (Guillaume's proportion with steel) to 33 1-3; the result gave an exceptionally fine material with a coefficient of .000004, only one-third that of ordinary steel. It is rather brittle, easily worked with lathe and file, entirely malleable, resisting rust to a marked degree, and affected by no acid except aqua regia. The smoothness with which it works against itself, contrary to the general experience, is remarkable.

Nickel steel (or nickel iron) will thus reduce the error of measurements due to temperature to one-eleventh of that of steel, leaving it at a figure so small as to be within the "personal" error of observation which is considered to be inevitable, and thus permitting temperature to be ignored altogether. The only thing that seems to stand in the way of its general use is its cost, due to the scarcity of nickel, the world's annual production of which is only about 7000 tons. The price of nickel is steadily rising, having increased by about one-third in the last two years. A ton of 36 per cent nickel-steel would now cost about three times as much as a ton of ordinary steel, a price that is prohibitory so far as building or machinery is concerned. There is no reason, however, why it should not be used extensively in instrument making, its price being still less than that of brass and only a fraction of that of platinum. Its use would add only a few cents to the cost of a surveyor's tape or to that of a pair of micrometer calipers and would save an immense amount of calculation. What its use would save in measuring base lines for fine geodetic work may be imagined when it is stated that at present an entire portable university is required for these, including heavy bars of platinum packed in melting ice, all of which could be dispensed with if nickel steel base bars were employed.

A PRIZE OFFERED FOR A RESPIRATOR.

Owing to the dangerous methods of inhaling contaminated atmosphere dangerous to the health, incidental to certain industries, the Society of Arts, London, offers a prize for the best dust arresting respirator for use in connection with such dangerous trades. The devices submitted must possess the following characteristics: The apparatus must be light and simple in construction; must be cheap, so that the filtering medium or the entire respirator can be inexpensively renewed from time to time as necessity demands, or should be of such construction that it can be quickly and easily cleaned; no air must enter the lungs either by the nostrils or mouth except through the filtering medium; it must not permit exhaled air to be rebreathed; the filtering medium must be of such construction that while an efficient dust arrester it does not impede respiration after being worn for several hours, through the medium's becoming clogged; and it must not be unsightly in appearance. All inventions must be submitted not later than December 31, 1903, and if the devices submitted have been in use, the experience of such utilization must be recorded.

SCIENCE NOTES.

News comes from abroad that Dr. Lunden claims to have experimentally proved that rays reflected from radium enable the blind to see partially.

A well-equipped eye dispensary will soon be traveling through the length and breadth of Egypt. Sir Ernest Cassel provided for this by a recent gift of about $100,000, and the Sanitary Department of the Egyptian government adopted the suggestion as the best means of carrying out the wishes of the donor. The dispensary will be supplied with all the most modern and approved apparatus, and will be housed in a tent, which will be moved from place to place as found desirable.

In a recent number of the Apotheker Zeitung H. Kuhl discusses the value of hydrogen peroxide as a disinfecting and deodorizing agent in toilet preparations and recommends as tooth-paste—calcium carbonate, 5 parts; soap, 1 part; rubbed up with glycerin and hydrogen peroxide solution, equal parts, to a suitable consistence. For a tooth-wash—glycerin, 2 parts; hydrogen peroxide solution, 2 parts, and rose water, 1 part, are recommended. For salves or skin-creams a basis of lanolin may be employed, with the addition of zinc ointment or cold cream.

In a recent number of the Gardener's Chronicle, W. C. Worsdell gives an interesting account of experiments that have been made to ascertain the means by which some plants are protected from the attacks of slugs and snails. Tannin appears to be one of the substances objectionable to them. Experiments made by Stahl showed that carrot, which from its sweetness and absence of tannin is particularly attractive to slugs, if treated with a 1 per cent solution of tannin remained practically untouched by the common small garden slug *Limax agrestis*, and if a solution of 1 in 1,000 of water be sprinkled on the animal, it rapidly disappeared from the scene of operation. Similarly, it was found that the leaves of *Valisneria*, *Trapa*, and other water plants containing tannin were avoided by the water snails, *Paludina*, *Limnæa*, and *Planorbis*, but if the tannin were extracted the leaves were speedily eaten. Acid sap has a similar effect; *Rumex acetosella*, *Oxalis*, and *Begonia* are disliked on account of the potassium binoxalate they contain. This was proved by soaking pieces of carrot in a 1 per cent solution of the salt and putting them before the slugs *Arion hortensis* and *Limax agrestis*, and the snail *Helix hortensis*, the pieces being untouched after a lapse of several days. A solution of the salt of 1 part in 1,000 of water was found to irritate the animals, and cause them to remove to other quarters. Plants with hairs secreting acids are similarly avoided, as in *Cicer arietinum*, *Oenothera*, etc. Ethereal oils are similarly protective; leaves of *Rue*, *Acorus calamus*, and *Mentha piperita* are carefully avoided by snails, but if the oil is extracted they are readily eaten. Bitter substances are also protective. Young leaves of *Gentiana lutea* and *Menyanthes trifoliata* are scarcely touched, though extracted leaves are at once devoured. But in autumn the bitter substances appear to be no longer efficacious.

THE CURRENT SUPPLEMENT.

The current SUPPLEMENT, No. 1436, opens with an excellent article on the Pyrmont Bridge at Sydney, Australia. Good illustrations accompany the article. The presidential address of James Swinburne before the Institution of Electrical Engineers is published. The address discusses some limits in heavy electrical engineering. To the engineer, one of the most interesting articles in the SUPPLEMENT is that which describes the Monarch system of engine stops, by means of which engines are immediately shut down in cases of emergency, so as to avoid accidents and the attendant loss of life and damage to property. The system described is remarkable for its simplicity and ingenuity. E. O. Hovey presents a very fully illustrated description of his explorations of the volcanoes of Martinique and St. Vincent. Sir William Crookes' striking address on modern views of matter, delivered before the Congress of Applied Chemistry at Berlin, is also published. Sir William Crookes discusses his subject with the eloquence which has always characterized his written work. The Paris correspondent of the SCIENTIFIC AMERICAN, continuing his description of the Paris-Madrid racing automobiles, describes in this installment the Mors automobile.

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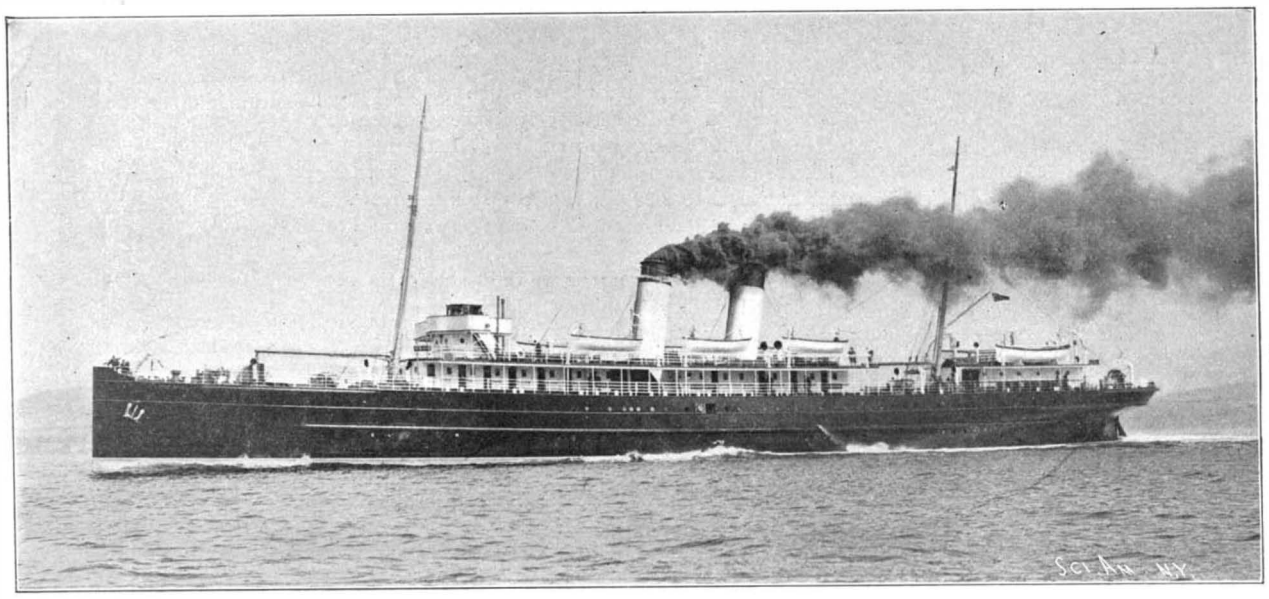
THE NEW CALAIS-DOVER TURBINE STEAMER.

The inauguration of a cross-channel, turbine steamer service which took place Saturday, June 27, marks another important step in the application of the steam turbine to marine propulsion. The new vessel is the first turbine passenger steamer to be used in deep-sea service, for her predecessors, the "Queen Alexandra" and "King Edward," were merely river boats intended for service in quiet waters. The new boat, however, which is known as the "Queen," will be engaged in daily service across one of the stormiest and roughest stretches of water in the world, and if she fulfills her promise, the turbine marine engine will have moved another step forward toward the day when, as we confidently believe, it will become the standard marine engine for all classes of service.



THE NEW TURBINE PASSENGER STEAMER "QUEEN" FOR THE CALAIS-DOVER ROUTE.

Length, 310 feet; beam, 40 feet; speed, 22 knots per hour.

Cross-channel steamers plying across the North Sea, the English Channel, and the Irish Channel have certain well-defined features which are easily recognized, and distinguish them sharply from the steamers engaged in similar service in American waters, such vessels, for instance, as the well-known Sound and Hudson River steamers. As a class the English boats are marked by low freeboard, narrow beam, and a comparative absence of deck-house accommodation. The "Queen," however, has a lofty freeboard, the cumbersome paddle-boxes have disappeared, and she has, for an English boat, fairly generous accommodations above the main deck. In point of lines and general contour she certainly looks to be a handsome and able sea-going craft. She is 310 feet in length and 40 feet in beam, or 5 feet more than the breadth of any previous steamer on this line. For about two-thirds of her length she is fitted with bilge keels, which will serve to keep her steady when she is running in the trough of the seas which prevail in the English Channel between Calais and Dover. The motive power consists of three turbine engines, driving three shafts. Originally the vessel had five propellers; but two have been removed, leaving one propeller on each shaft. The live steam enters first the high-pressure turbine on the center shaft, where it is expanded five-fold. It then passes to the low-pressure turbines on the side shafts, where it is expanded twenty-five fold, and from the low-pressure turbines it passes to the condensers. When under way clear of the harbors, all three turbines will be in action in the go-ahead direction; but in making a landing the outer shafts only are in operation, the vessel thereby securing all the advantages of maneuvering due to twin-screw propulsion. For reversing there is placed inside the exhaust end of each low-pressure turbine a reversing turbine, suitable valves changing the flow of steam from the go-ahead to the go-astern direction. The "Queen" was built for the Southeastern and Chatham Railway Company, for the Calais-Dover route, which forms an important link in the through service between London and Paris. On her first trip across the Channel, above referred to, she maintained an average speed of twenty-two knots an hour, and at times ran considerably over that speed. On board the vessel were the Hon. Charles Parsons, the inventor and designer of her turbines, Col. Denny, the builder, and several American guests. According to Mr. Parsons, the cost of the ship was about $425,000, or practically the same as that of a vessel of her size fitted with reciprocating engines. The great advantage of the turbine installation is that there is a great reduction in weight and space for a given output of power on the propeller shafts. In the present case, from the foundations to the top of the turbine it is only six feet, whereas reciprocating engines of the same power would require about three times as much height to clear them. The expense of overhauls, which have to be very frequent on reciprocating engines, is practically eliminated on the turbine engines, the "King Edward" during the few years that she has been in service on the Clyde having cost practically nothing for repairs.

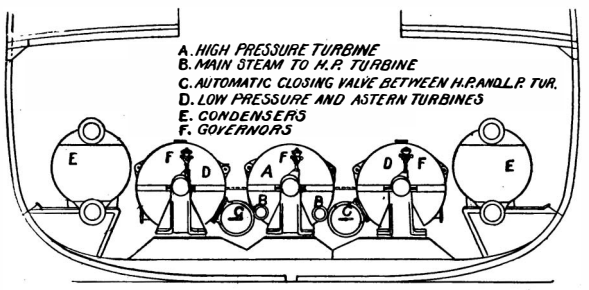

A. HIGH PRESSURE TURBINE
B. MAIN STEAM TO H.P. TURBINE
C. AUTOMATIC CLOSING VALVE BETWEEN H.P. AND L.P. TUR.
D. LOW PRESSURE AND ASTERN TURBINES
E. CONDENSERS
F. GOVERNORS

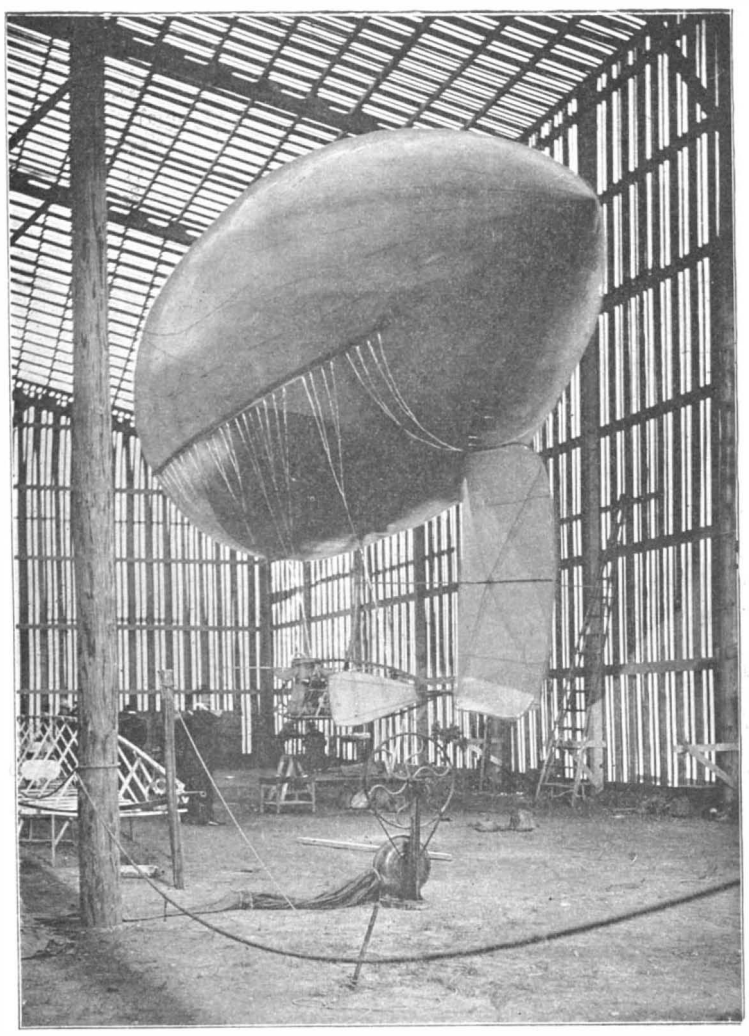
DIAGRAM SHOWING POSITION OF TURBINES.

Now that the turbine has been successfully installed on deep-sea channel service, the next natural step will be the construction of a transatlantic steamer with turbine motive power. Mr. Parsons affirmed on the occasion of the trial trip of the "Queen" that all the advantages shown by the turbine in river and channel steamers, will be realized in an increased ratio on the larger vessels for ocean service. This is a perfectly reasonable expectation. Turbines of 10,000 horse power are now being built, and will shortly be installed for electrical power station work, and there would be no theoretical or mechanical difficulty encountered in the installation of three or more turbines of similar size on a fast ocean liner; while the reduction in dead weight and the additional space that could be devoted to passenger accommodation would be very considerable.

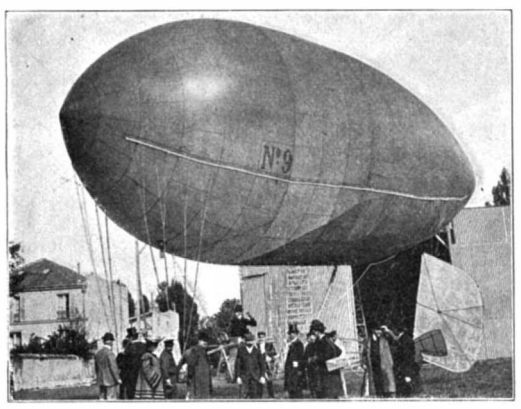
THE NEW SANTOS-DUMONT AIRSHIPS.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

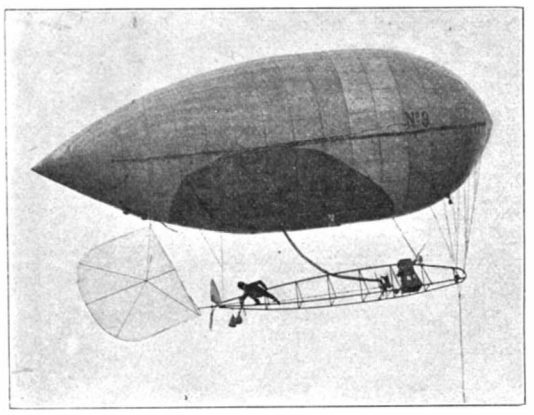
Santos-Dumont's new airship, the No. 9, has been tried in the neighborhood of Paris with considerable success. The tests thus far made may be considered as experiments with the new egg-shaped form of balloon before building a larger airship on the same plan. The vessel is the smallest airship ever built. Its gas capacity is only 340 cubic yards. On the 8th of May the new airship started from the balloon shed and sailed over the maneuvering grounds of the Bois



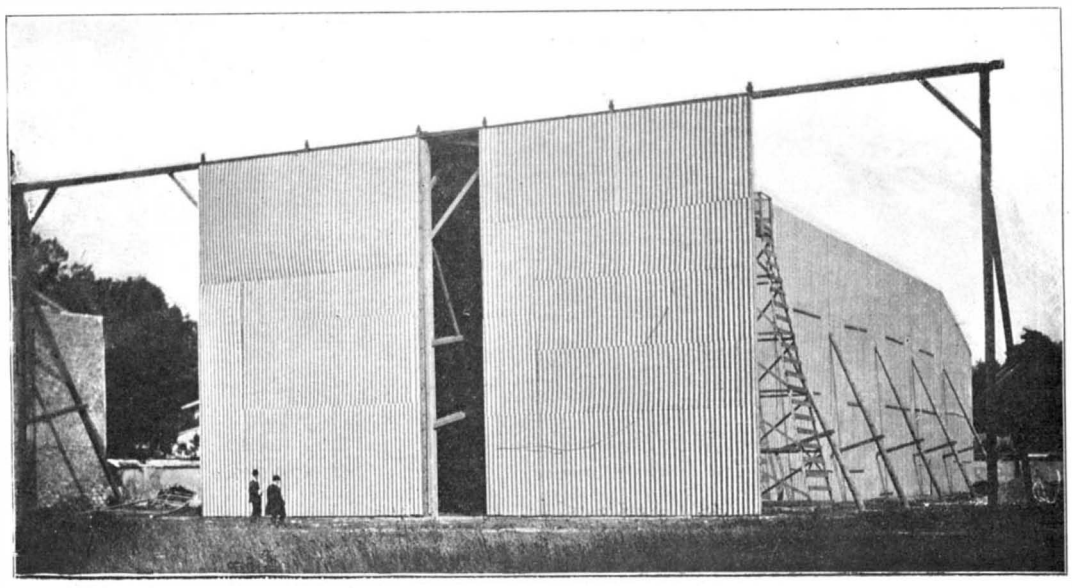
Interior of the New Shed, Showing the No. 9 and the Framework of the New St. Louis Racer.



Ready for the Start.



Santos-Dumont Shifting the Ballast-Bags.



Santos-Dumont's New Balloon Shed.

THE SANTOS-DUMONT NO. 9 AND ITS SHED.

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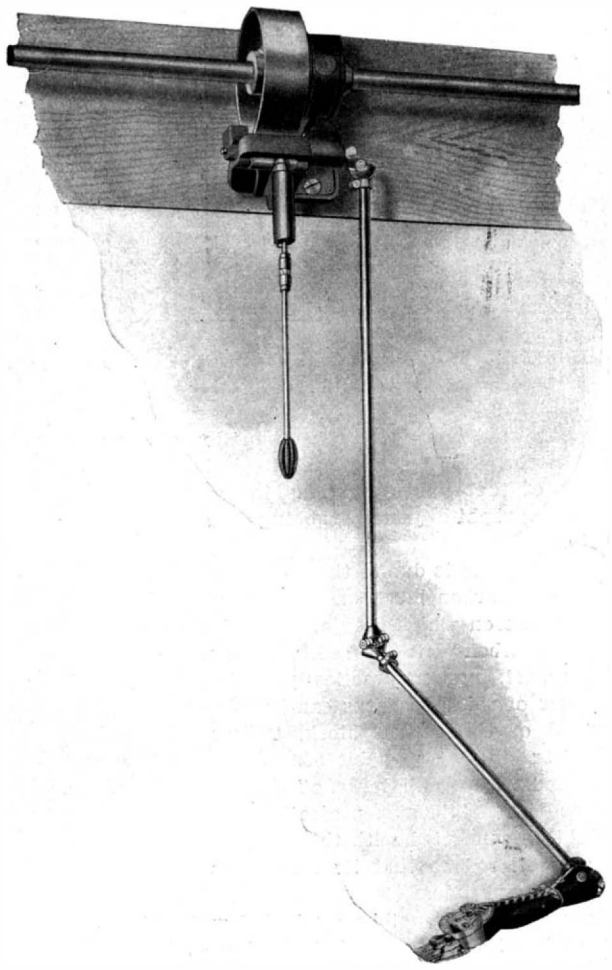
de Boulogne, carrying a trail rope 100 feet long. The balloon could be steered with ease and went through a number of evolutions, going first in one direction, then in the opposite, turning about and traveling against the wind, rising and descending; and seeming to be fully under the control of the aeronaut. A second series of trials similar to the first were made on the 21st of May over the same ground and lasted an hour and a half. After sailing in different directions the airship alighted on the grounds of the Polo Club, taking its flight again, and after another series of evolutions, in which it was controlled with ease, it landed finally near the balloon shed. One of the engravings shows the airship ready to start from the balloon shed on its trial trip, with Santos-Dumont in the car, while the second shows it sailing over the Bois de Boulogne, the aeronaut being shown in the act of shifting the sand-bags which are used to balance the car. The position of the propeller and the rudder will be clearly observed.

The new No. 9, which was described at the time of its construction (in the SCIENTIFIC AMERICAN of December 20, 1902) is not intended to make any great speed, as the balloon body is of egg-shaped form and travels with the large end foremost. This construction makes it steadier than the pointed form. Hence the balloon is not as likely to pitch. The experimental No. 9 having proved so successful, the new No. 10, which is to be the largest airship yet built, and which will carry ten persons, will be constructed on the same lines.

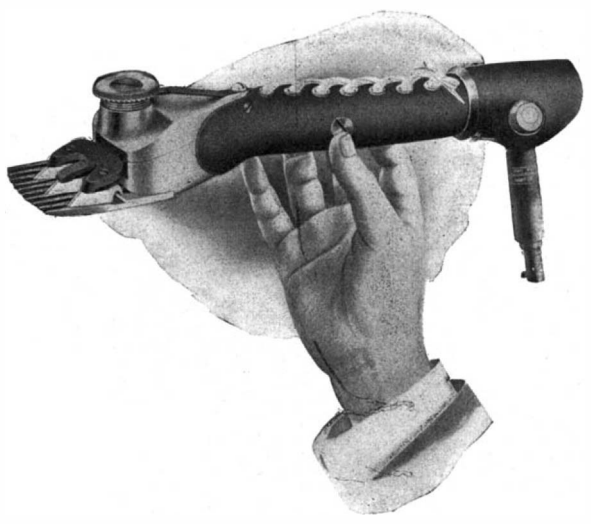
Santos-Dumont has erected a vast balloon shed on the bank of the Seine just outside the city. It consists of a framework of beams covered at the sides as well as the top with a red and white striped awning. One feature is the ease with which the front may be opened to let out the airships. The two frames which form the sliding doors and uncover the whole end of the shed are mounted on rollers upon an upper framework, and are guided below on rollers, so that they can be easily slid back and forth. In our engraving the aeronaut will be noticed in front of the shed, on the extreme left.

The new Clement gasoline motor used on the No. 9 has proved especially satisfactory. The little motor with its two cylinders joined in the form of a V to a round aluminium crank box, seems like a toy and weighs but 26½ pounds, although it will develop 3 horse power. The weight per horse power (8.8 pounds), the smallest that has yet been reached, is the result of a long experience in racing cars, where



SHEARER DRIVEN FROM AN OVERHEAD SHAFT.

the weight must be cut down to the minimum. Current for the spark is supplied by a battery and induction coil of the motor-bicycle pattern. The motor is connected through a light friction clutch to the long shaft which passes back of the propeller. A bicycle wheel with a heavy rim (without the tire) forms the flywheel and lies next the motor. The main framework remains about the same, but has been shortened by about two feet at the front end and is now rounded off. The position of the gasoline tank (containing 2½ gallons) has been changed, and is now hung on the rear of the basket. The rudder is formed of canvas stretched on a very light bamboo framework and measures about 10 feet square. The pilot wheel which controls the rudder is mounted just in front of the basket, and on the same shaft is a second and smaller grooved wheel carrying the cord which mounts up to the balloon body and then passes back over a set of pulleys to the rudder. The wheels are of aluminium, as in fact are most of the metal parts outside of the motor cylinders, and main shaft. The aeronaut has also at hand the cord of the escape valve as well



THE CLIPPER.

as the different levers for operating the motor. An air-bag of 60 cubic yards lies along the inside of the balloon at the bottom, forming a pocket which can be filled out with air by a fan mounted on the motor shaft. The balloon is always kept in shape as the gas escapes. The propeller, 12 feet in diameter, makes 200 revolutions per minute. The balloon body is only 45 feet long, while the framework is now but 27 feet. The complete airship weighs only 200 pounds.

Alongside the balloon shed has been installed a hydrogen generator of large capacity to be used for this and the future balloons. Tubes of compressed hydrogen are at hand for emergencies. One of the engravings shows the inside of the balloon shed with the No. 9. The shed will soon contain as many as three new airships, as Santos-Dumont is now building two new ones, the large No. 10 which is to be a touring balloon, and the new racer No. 7 with which he is to enter the St. Louis contest of next year.

The work on the No. 7 is already well advanced. The car which is 97 feet long is almost finished and will be observed on the left. The design of the new racer is almost entirely fixed upon. It will have a capacity of 1,650 cubic yards and will have the form of an elongated ellipsoid measuring 159 feet long and 23 feet across the middle, thus giving a ratio of 1 to 7. The two ends will be pointed. The envelop of the balloon will have 850 square yards surface. It is composed of two thicknesses of French silk pasted together and the whole will weigh 528 pounds. The balloon is divided into three compartments each having a volume of 550 cubic yards. The two partitions, which are of unvarnished silk, have a surface of 75 square yards and weigh 15 pounds. Near the center of the balloon are two interior air-bags of unequal size and communicating with each other by a canvas sleeve. The surface of the air-bags is 150 square yards and their weight 62 pounds. The car-frame, 67 feet long and 4 feet high in the middle, will be suspended from the balloon by 102 steel wires. A Clement petrol motor of 60 horse power will drive two propellers of 12 feet diameter, both having the same screw pitch. The propellers will be fixed at the front and rear of the car-frame. The basket of the aeronaut will be placed in the center of the car-frame. This new arrangement will tend to increase the pitching of the airship, and to overcome this, two pairs of horizontal planes will be placed to the forward and rear of the center of the framework, each lying on one side of the axis. These planes will measure 6 by 6 feet or 36 square feet each, or in all 144 square feet; they are to be movable and will be controlled by a set of levers. The rudder, whose axis will be vertical, will have a surface of 10 square yards. It is expected that the new racing balloon will make a speed of 60 feet or more per second. Santos-Dumont expects to finish it about the first of July, when it will be put through its trial tests.

A MECHANICAL SHEEP-SHEARER.

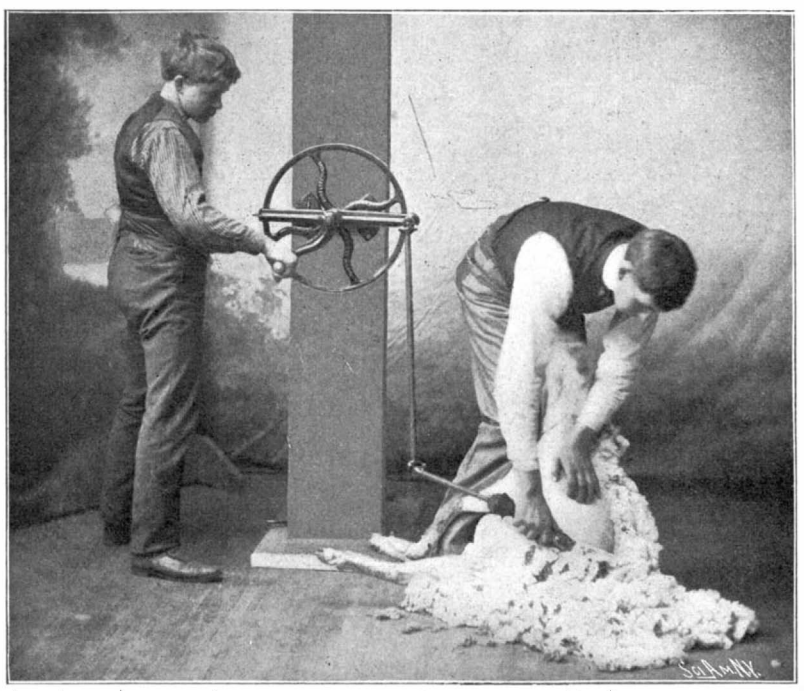
Among the variety of labor-saving apparatus which have been invented in recent years for the benefit of the farmer, one of the most interesting machines is that which relieves him of the work of removing the fleece of his sheep by means of the ordinary hand shears. A mechanism is now being used on the sheep farms of the West as well as other portions of the United States which performs a remarkable amount of work when contrasted with the method which has been used in the past. It works by means of a flexible shaft. The knives or shears can be operated as rapidly as the gearing contained in the shaft can be moved.

The sheep-shearing machinery can be operated by hand, by steam, or electric power, as desired. The cutting instrument proper is quite similar to the familiar clipper used by hair dressers and also for clipping horses, but varies in size according to the requirements. It includes a steel comb for separating the wool and allowing the knives to sever it closely to the skin. The cutter consists of three teeth or blades bolted to the framework of the shears in such a manner that they play freely, as shown in the illustration. They can be removed readily for sharpening whenever necessary. The cutting apparatus is connected to the lower of a series of steel spindles incased in tubular sheaths. The upper spindle terminates in a cog wheel which engages the teeth of a similar wheel at the end of what might be called the driving shaft. When the apparatus is operated by steam or electric power, this shaft is belted to a pulley.

Where power is furnished by hand, a crank is used to turn a driving wheel. The rim of this bears a series of cogs whose teeth fit into the driving shaft connected with the flexible shaft. By turning the handle of the crank wheel, a man or a boy can furnish sufficient power to operate two shearing machines at once.

The operation of shearing is performed so rapidly by this method that the workman can remove the wool practically as fast as he can push the cutter through it. Usually the plan followed is to guide the shears with the right hand, holding the animal in proper position with the left hand and the knees. As a rule the wool is first removed from the lower portions of the body, gradually working up the sides in such a manner that the skin is prevented from wrinkling and offers a smooth surface to the cutter. An expert shearer by this method can crop off the fleece almost completely, leaving the animal clean, as shown in the accompanying photograph. Some of the records made by expert shearers with the apparatus have been really remarkable, one man taking off 2,650 pounds of wool from 360 animals in less than 15 hours with such a cutter, shearing over 20 sheep per hour. The average shearer, after he has become familiar with the machinery, can without difficulty cut from 150 to 200 fleeces in a day of 10 hours.

Where a power plant is installed it is usually placed in a building large enough to carry shafting and pulleys, from which are suspended the shafts working the cutters. As a single cutter can be operated at full speed by ⅛ or 1-6 horse power, an engine of 8 or 10 horse power is sufficient to drive an extensive plant. One which has been installed on a ranch in Wyoming contains fifty machines, which have a capacity for shearing over 1,000 animals an hour. It is estimated that the entire expense, including labor, fuel for the engine, and wear and tear of the mechanism, averages between $20 and $25 for 100,000 head of sheep shorn, the average price paid the operator being



SHEARING A SHEEP BY HAND MACHINE.

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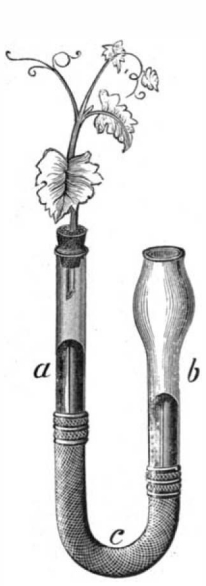
8 cents an hour. In removing the fleece no effort is made to clean the wool, and frequently the material is not only gummy but filled with fine sand, yet the work can be done so neatly that when the fleece is removed, the skin is not even scratched.

The live stock raiser who owns a flock of a thousand sheep, can do all his shearing with the aid only of a boy to turn one of the hand machines. This is one reason why the machine's use has become so extensive not only on the large ranches of the West and Southwest but on the smaller places where only hand power can be utilized to advantage. This mechanism has been substituted so extensively for the ordinary hand shears, that the latter implement must become in the near future as obsolete as many other tools, which ten years ago were considered indispensable in carrying out agricultural work.

THE WATER-ABSORBING PROPERTIES OF PLANTS.

The consumption of water in the cultivated plants is very considerable. It has been found that Indian corn, during its period of vegetation, uses up 31 pounds of water, while hemp and sunflower require 59 pounds and 145 pounds respectively. Still larger, of course, are the quantities for the trees whose leaves take up a very large surface and are capable of exhaling enormous quantities of water. The water which leaves in the form of vapor through the stomata of the leaves and circulates in the smallest plant as well as the largest tree, up into the extreme ends of the branches, has to be raised to this height. When we consider the large quantities of water that are given off by even a medium-sized tree, we recognize the fact that a huge force is required to lift the large volume of water and expedite it. We only need to tear off a leaf or the stem of a herb-like plant, to become convinced that the water is not conducted in the form of vapor, but in the liquid state. What powers, therefore, are at work performing this gigantic task?

This question is also answered by the physiology of plants in conjunction with physics. Through every plant, beginning in the finest, hair-like roots, runs a connected system of canals, the fibro-vascular strings (vascular bundle) which ramify into all parts of the plant and meet our eye in the leaves as ribs and nerves. These strings are the water conduits, but we have yet to look for the pumps by means of which differences of height are overcome between root and crown, sometimes amounting to as much as 328 feet. When we contemplate such a fibro-vascular string, we observe that it is reinforced in many places by peculiar formations, by spiral vessels, etc. These structures serve no other purpose than to increase the solidity. Furthermore, the vascular bundles, which are usually lignified themselves and no longer carry any living protoplasm, are surrounded by the vascular sheath consisting of thin-walled, live cells. These cells are nothing more or less than osmotic apparatus; it is they which cause by means of the osmotic force the ascension of the sap current.



Demonstration of the Absorbing Power of Transpiring Leaves.

a, b, Glass tube filled with mercury. c, Rubber tube.

Their action is exercised in two different ways; they are able to press as well as absorb, and by the co-operation of both forces, considerable quantities of liquid are dispatched in the plants. If plenty of liquid is supplied to these cells from the environs, as is the case especially in the roots, they will force a portion of this liquid with strong pressure into the vessel. On the other hand, if they are situated in the water-exhaling leaves, water will be abstracted from them by the adjoining cells, and in order to fill up again, they will absorb water from the vessel.

Both co-operating forces, the pressure emanating from the roots and the absorbing power occasioned by the evaporation of water from the leaves, are considerable. We can easily convince ourselves of this fact by observing a well-known process, the so-called bleeding, i. e., exudation of sap from wounds made on plants in the spring before the formation of foliage. Then it will be seen how large an amount of liquid flows from the places, and when the stem of a plant is cut off smoothly and fixed in a manometer filled with mercury, the quicksilver is lifted to great heights. In the grapevine, for instance, a root pressure has been found, capable of keeping the balance of a mercury column 3½ feet high. The absorbing power is likewise very great; and if a leaf-bearing twig is inserted in a manometer filled with mercury, and the space between the cut and the quicksilver filled with water, the mercury is drawn up in proportion as the twig exhales water. This may take place to such an extent that the mercury in the two legs of the manometer will show a difference in height of 30 centimeters. For the engraving as well as the foregoing text we are indebted to *Der Stein der Weisen.*

Electrical Notes.

News comes from abroad that a German company is running a number of electric tug boats for touring purposes regularly between Zehrdeuick and Berlin. The dimensions of the boats are from 46 feet to 49 feet long and 10 feet wide, and they have a draft of 3.4 feet. We understand that these boats are also used for towing barges up and down the canal, their displacement being considerably less than that of steam tugs of equivalent drawing power, and they are therefore peculiarly suited to towing purposes in shallow and winding canals. We regret that no information is given as to how the electrical energy is obtained—whether from accumulators on the boats or from an overhead line. Electric haulage on canals on the Continent and in America is usually accomplished by tractors running along the banks and receiving current from overhead trolley wires.

At a recent meeting of the British Institution of Electrical Engineers in London the results of the experiments with the Nernst electric light for public lighting purposes were given. A mile of a street in Hackney, one of the London suburbs, has been lighted by means of these lamps to obtain conclusive data regarding their durability, efficiency and suitability for such work. The main difficulty experienced was in connection with the starting of the light. This, however, was overcome by means of the automatic heater, which is put out of action directly the lamp lights up. But the result of this attachment was not attended with absolute success, since considerable uncertainty exists in connection with the durability of the glower. Some glowers lasted only 15 hours, while others remained efficient for 1,070 hours, but the average life was 305 hours. This lack of uniformity constitutes one of the greatest objections to the wider utilization of the Nernst lamp for public lighting, despite its superiority in many other important features, and will necessitate considerable improvement before it is extensively adopted for illumining the streets, with that economy which is essential for such purposes.

Alfred Cowles read a paper before the Electro-Chemical Society at Niagara Falls, the subject of which related to the rather remarkable fact that an even 100-ampere current in one sidereal day liberates by electrolysis just one cubic meter of hydrogen under standard conditions. These agreements are so close that they should be of great practical value, for the reason that it becomes easy for students to master the table of electro-chemical equivalents. Mr. Cowles has kindly sent us a memorandum giving the exact data upon which his calculation is based, and the exact results. If the atomic weight of hydrogen be taken as one, and the calculation is based on Dr. Edward W. Morley's determination of the weight of a liter or cubic decimeter of hydrogen, 0.089873 ± 0.0000027 gramme, as given in Dr. Morley's paper on the Atomic Weights of Hydrogen and Oxygen, in the Smithsonian Contributions to Knowledge for 1896, we must then attribute to silver an atomic weight of 107.11. Lord Rayleigh's determination of the electro-chemical equivalent of silver is 0,001118 gramme per coulomb. This would make the electro-chemical equivalent of hydrogen 0.00001043786 gramme. Under these premises, the kilocrith col, or 100 international amperes for one sidereal day, liberates 1.00071 cubic meters under standard conditions of pressure and temperature. The meter is not exactly one ten-millionth part of the quadrant of the earth from the pole to the equator. The most reliable data as to the distance from the pole to the equator, is the determination made by Clarke in 1880, based upon all the arcs of the earth that had been measured up to that time. He found the distance from the pole to the equator to be 10,001,868 meters. Were we to correct the length of the meter in the light of this more reliable data, the cubic meter would then become a trifle larger, and the 100-ampere current would then give 1.00015 cubic meters of hydrogen at 0 deg. C. at the pressure of the atmosphere at sea level and 45 deg. latitude in one sidereal day. The sidereal day is 86,164.091 mean solar seconds, and measures the true revolution of the earth on its axis. This agreement is so close that it is well within the limits of error of the determinations of the various constants, and it naturally raises the very important question as to whether the agreement is absolute or not. Taken in connection with the law of Avogadro and the valencies of the elements, this agreement reaches to every element in chemistry. Hence, if this connecting link could be proved fundamental, the periodic law, the law of gravitation, and Coulomb's law of attraction between electrically-charged bodies, could all probably be brought within the scope of some broader generalization.

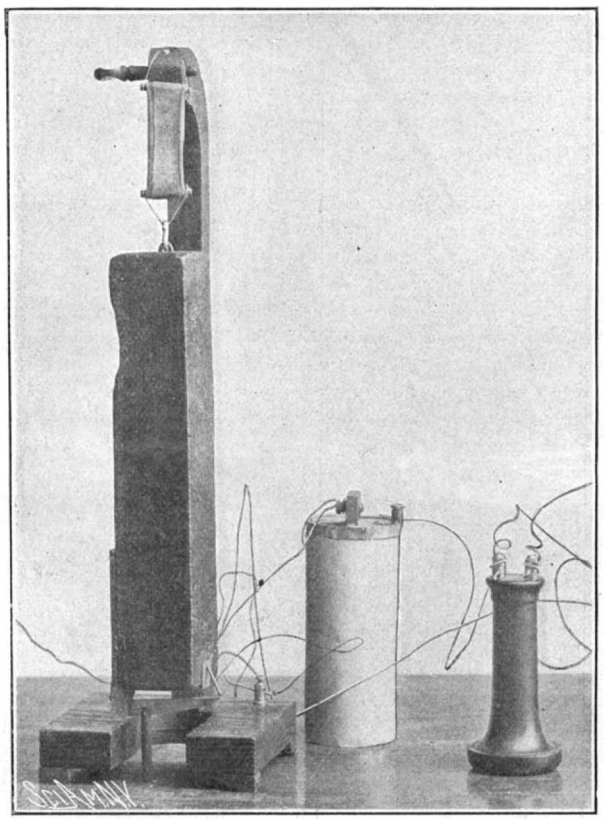
AN INSTRUMENT FOR DETECTING DELICATE ACOUSTIC VIBRATIONS.

BY SHIRL HERR.

Students of acoustics have found that the lowest number of successive vibrations per second that will produce sound is sixteen. Slow vibrations of solid bodies may be detected by the sense of touch, provided they are of considerable amplitude, but delicate vibrations having a rate lower than sixteen in a second produce no sensation whatever. The writer has constructed an apparatus that renders audible many of these insensible vibrations. This apparatus, however, can be used only for detecting the vibrations of solid masses which present a horizontal surface such as floors, pavements, etc. It is constructed in the following manner:

A weight of about ten pounds is suspended from the arm of a standard by means of a stout rubber band, and has cemented to its side in a vertical position a small carbon plate. A carbon block is placed directly on the surface of the vibrating body, and on this is set a slender graphite pencil which is inclined at a slight angle against the carbon plate on the weight. The carbon plate and the carbon block are then connected with a battery and a Bell telephone.

If this apparatus is placed on a wood floor the jar of the heart beat of any one standing near it will cause it to produce distinctly audible vibrations in the telephone. It is also sensitive to the jar of a distant concussion, such as thunder at a great distance. Delicate tremors and vibrations from any source produce audible vibrations in the telephone, but such audible vibrations are not in any case a reproduction of the original vibrations. These sound-producing vibrations are the result of the rapid variations in the current caused by the graphite pencil rubbing against the carbon plate.



A MODIFIED MICROPHONE FOR DETECTING FEEBLE VIBRATIONS.

This rubbing is due to the fact that the graphite pencil and the carbon block on which it rests vibrate with the surface on which they are placed, while the weight and the carbon plate secured to it, because of their elastic support, remain practically motionless. The sensitiveness of this apparatus can be slightly increased if, instead of the carbon block, the graphite pencil is permitted to rest on a bit of platinum secured to the free end of a small lever. This lever, which is fulcrumed in a rigid arm projecting downward from the weight, is connected with the vibrating body by means of a small rod so that its free end vibrates with increased amplitude.

Experiments cannot be conducted satisfactorily at a time when there is any wind blowing, or in the neighborhood of any constant jarring such as that caused by the traffic on a city street, a waterfall, etc.

Gifts to American Libraries in 1902.

At the twenty-fifth annual meeting of the American Library Association, a report was read by J. L. Harrison, from which it would appear that 96,247 volumes were given to the libraries of the United States during the year 1902, in addition to $10,306,407.61. Mr. Carnegie's gifts for the year number 158 and amount to $6,679,000. They were for buildings, and were given subject to the usual conditions that a site be provided and that ten per cent of the amount of the gift be pledged for annual maintenance.

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Correspondence.

Integration of the Negro by the American Nation.

To the Editor of the SCIENTIFIC AMERICAN:

A prominent New York clergyman recently stated that the American negro would never contribute toward forming the future American race, and because of the racial physical characteristics the negro would never be assimilated by the American nation. Already this eminent theologian has been quoted as an authority in the science of anthropology. Is there a scientific or historic warrant for the views expressed? As a matter of purely scientific interest, it seems that this eminent and scholarly theologian is a stranger to the science of ethnology.

If the results of the painstaking researches of such scientific minds as Dr. Guisseppe Sergi, professor of anthropology in the University of Rome, at Rome, Italy (in his history of Mediterranean races); the late Dr. Brinton, of the Philadelphia Academy of Natural Sciences; Prof. William H. Holmes, of the Bureau of American Ethnology, Washington, D. C.; Dr. Lester F. Ward, of the Department of Anthropology of the United States National Museum, at Washington, D. C.—if the combined results of the scientific inquiry of these eminent ethnologists are true, then we must be led to believe that the American nation can and it has assimilated the negro and alien races besides.

Sergi and Brinton hold that the Caucasian races of Europe, in some prehistoric time, originally came from Northern Africa; hence these eminent scientists call them Euro-Africans, denoting their African origin. Science further teaches that the prominent physical characteristics which now seem to be the prominent demarkation between the African and European races are due to the active rays of the sun; and as the Europeans have been removed from the conditions which produce the characteristics, viz., sun, altitude, dwelling in a colder climate, habits, education, environment, etc., have modified the European's original appearance. Will not these same conditions in America produce on the negro the same modifications as they produce upon the Euro-African? If not, why? Then, again, what is assimilation? It is the process of making one element harmonize with the other. Scientific observers have shown us that it is both a physiological and psychological process. Lester F. Ward, in the current issue of the American Journal of Sociology (May, 1903, page 732), says of physiological assimilation: "Great efforts are made to prevent the mixing of the white with the black races, but they are only partially successful. Whatever may be the present condition of things, and however great may be the obstacles to race mixture, it is clear race integration will go on until all the races shall be blended into one." The intellectual process which goes on day by day in the public schools; oneness of national ideals, traditions, and language; contact with our civil, religious and political institutions, tend to harmonize racial proclivities and singularities, and produce a type of mankind to which all the races have contributed their integral share. It is a matter of purely scientific interest to the ethnologist and scientific observer to note the progress of this American assimilation. JAMES M. BODDY.

Troy, N. Y., May 25, 1903.

The Freaks of Lightning.

To the Editor of the SCIENTIFIC AMERICAN:

Anent the article in your issue of May 30 under the heading "A man who was struck by lightning and lives" (his clothes torn into shreds), I would say that some fifty and odd years ago I was witness to the fact that one Polette, of St. Michel de Bellechasse, P. Q., and then about eighty years of age, while in kneeling attitude in the little chapel of Ste. Anne, about a quarter of a mile eastward of the parish church, was struck by lightning, with the effect that while he was only dazed for a while by the stroke, his clothes were torn asunder all along his backbone from neck to base of trunk, where the lightning bifurcated, and thence following the marrow along each of his legs, finally escaped through the heels of his boots.

This tendency to bifurcation of the current, from trunk to limbs, when, as in the human system, the nerves of the legs exert an equal pull upon the central column, is further illustrated by the fact that at Peoria, Ill., an individual, struck by lightning and who was otherwise uninjured, except by being for a moment dazed as in the case of old Polette, found that the electric fluid, after traversing his nervous system from head to foot, or rather feet, had finally passed out through the soles of his boots. Again, as in the Polette case, the fact was evidenced by two tiny holes, one in each sole, through which the fluid had tunneled for itself an exit.

Some twenty years ago the apex of the roof of a house in the same village of St. Michel was struck by lightning, which trifurcated or divided into three branches or currents: the one descending west along the roof sloping toward that side, the second north, and the third south respectively, tearing away the shingles on their way to and following down the central bolts or iron fastenings of as many windows situated one on each of the three sides of the house, tearing away the fastenings and portions of the woodwork of each window in their respective trajectories toward the earth.

At St. Michel again, near Beaumont, I was witness to the fact that, as I passed by during a thunder storm, a man trending toward his home in an adjoining field, was struck dead by a flash of the electric fluid from the clouds, and remained suddenly motionless, erect and in the same attitude as when overtaken by the death-dealing shaft.

But the strangest and most beautiful display of lightning or atmospheric electric currents, which it was my good fortune to witness, it being the only time in my life I ever saw anything of the kind, was out on the Beauport flats near Quebec, when, as I then wrote to Flammarion, of the Société d'Astronomie de France, two electrically-laden clouds, as though two trees, their heads toward each other, and their longer branches interwoven, kept on for fully more than ten minutes, interchanging horizontal flashes of beautifully-colored fire, not one of which ever reached the earth; while occasionally a flash would shoot upward as if toward some cloud in that direction, but which I could see no sign of.

You would have given almost anything, Mr. Editor, to have been witness to this, of all the displays of my long life, the most enchanting. C. BAILLARGÉ.

Quebec, June 7, 1903.

Siloxicon—A Word from Its Discoverer.

To the Editor of the SCIENTIFIC AMERICAN:

The descriptions of the new refractory substance, siloxicon, that have recently appeared in the newspapers have created such a widespread interest, as evidenced by the numerous inquiries received from all parts of the country and all lines of industry, that it is desirable to correct a statement that was contained in these publications.

It was there stated that siloxicon was inoxidizable, but recent investigations have shown that this is not true. When it is heated to, or above, 2,674 deg. F. in an atmosphere containing a large amount of free oxygen, decomposition occurs.

Siloxicon, while variable in composition, may be represented by the formula Si_2C_2O; and when heated, as above stated, in presence of free oxygen, decomposition takes place, probably in accordance with the following equation:

$$Si_2C_2O + 7O = 2\,SiO_2 + 2\,CO_2.$$

If the siloxicon be in the form of a brick or other molded mass, the reaction occurs on the surface, producing a vitreous glaze, which in most instances is tinged light green from the presence of iron.

In the absence of free oxygen or in a reducing atmosphere no such decomposition occurs, and the temperature may be raised to the point of the formation of carborundum, or approximately 5,000 deg. F., before any change occurs, and then it takes place, it is thought, in accordance with this equation:

$$Si_2C_2O = SiC + Si + CO.$$

Solid carborundum remaining, while the vapor of silicon and carbon monoxide are given off.

It is interesting to note that after having discovered this oxidation of siloxicon, tests were made with carborundum, and it was found to be affected in a manner exactly similar to siloxicon; this notwithstanding the fact that for more than twelve years it had been generally considered inoxidizable.

Niagara Falls. EDWARD G. ACHESON.

The Jointed Snake Again.

To the Editor of the SCIENTIFIC AMERICAN:

Under the caption "A Jointed Snake," in your issue of May 16, page 374, the positive assertion is made that there is no animal known to science that has power to reattach any amputated portion of its anatomy. However this may be, the writer lived in Florida several seasons, and at different times came across a small snake-like appearing animal, about the size of an ordinary lead pencil, but about fifteen inches long. This animal was of reddish milk-like color, or resembled in color the dull glow of the opal. When struck with a sharp instrument, like a hoe, part of its body would be severed, but would immediately come together again. The first time the writer saw this unusual occurrence, his attention was called to the object by his father, and he has frequently seen the same thing since that time. The animal does not live on the surface, but is generally found in loose sandy soil.

Snake stories are generally associated with "little brown jugs," and by some people considered the aftermath of "high jinks" of a spirituous nature, but the fact is that these observations were made when the writer was not more than twelve years of age. Your explanation of the lizard and tail-growing ability is evidenced in many ways in Florida almost every day to the careful observer, who can watch these spry little animals dart in and out under the board sidewalks. But this snake-like animal is different, inasmuch as it has all the general attributes of the snake.

Chicago, Ill., May 21, 1903. H. HARRIS, JR.

Results of the Gordon Bennett Cup Race.

The fourth international automobile race for the Gordon Bennett cup, which took place in Ireland on July 2, was won for Germany by a 60 horse power Mercedes car owned by an American—Mr. Clarence Gray Dinsmore—and driven by the intrepid Belgian engineer, M. Jenetzy. Jenetzy's elapsed time for the course of 368 miles, 765 yards, was about 10 hours, 8 minutes; but, with the deductions for controls taken out, his running time is reduced to 6 hours, 36 minutes, 9 seconds, or an average of 56¼ miles an hour, as against Gabriel's average of 65 miles an hour in the recent race from Paris to Bordeaux. Chevalier Réné de Knyff, on a Panhard, finished first, two minutes ahead of Jenetzy, but as he started fourteen minutes ahead of the latter, he was beaten by 10 minutes. Henri Farman, on another Panhard, won third place, making only about four minutes slower time than Knyff; and Gabriel, on a Mors machine, was fourth. Edge, on his Napier, was the only member of the English team to finish, and he came in long after the race was officially ended. He was the fifth and last of the competitors to finish. As far as the American team was concerned, the race was even more dismal a failure than it was for the English. Winton had trouble starting his eight-cylinder motor, and was over three-quarters of an hour getting it going, after he had been officially started by being pushed over the line. He complained that there was water in the gasoline. Mooers' machine broke down while making the second circuit; while Owen only completed five out of the seven loops to be covered.

The course was, roughly speaking, in the shape of a figure 8, there being two loops—an eastern and a western one. Each competitor was to go three times around each loop, and once in addition around the larger, or western one. The course was well guarded, as a result of which there were no accidents to spectators, and but one to any of the contestants. This one happened to Jarrott while he was going around the larger loop for the second time. His steering gear broke, and he ran into a bank, was pitched out, and broke his collar bone. His mechanic was more badly injured, but Jarrott managed to get him out from under the car and have him taken to a hospital.

While repairing a punctured tire in the early part of the race, Foxhall Keene discovered the rear axle of his Mercedes car was cracked, so he quit the race, fearing a breakdown. The rear axle of Baron de Caters' Mercedes broke when he was but 10 miles from the finish and stood a good chance of winning second place. So this makes it appear as if the Daimler Company had gone beyond the safe limit in light construction of their racing cars. The machines they entered in the race were of 60 horse power, the 90 horse power racers that were specially built for it being unfortunately destroyed by a disastrous fire in their Cannstatt works a few weeks ago.

The bad performance of the American cars is stated to be due, also, to too light construction, although both of the Winton machines had trouble with their gasoline system.

Henri Farman, who came in third only a few minutes behind Knyff, said that he had all the little troubles with the motor, etc., that could possibly befall him without putting him out of the race.

The race has furnished one more proof of the soundness of construction of the leading French and German machines, and has shown quite definitely the limits of lightness beyond which it is not safe to go. Once again the race has gone not to the new and untried cars of excessive power, but to those of standard manufacture and comparative medium powers, which have been developed and brought to their present approximate perfection by a number of years' experience in road racing.

A Correction.

In the article on railroad ties and our forest supply, in our issue of June 27, the total number of ties on all the railroads of the United States should read 563,200,000, and the ties required annually, 112,640,000, the other figures, relating to linear measure, being modified accordingly.

Among the patents granted recently was one in the name of Elisha Gray, of telephone fame, who died some time ago. The patent referred to was for an electromechanical governor to be used on locomotives, which, it is said, will save much wear and tear on the engine and roadbed. One of its most important functions is to prevent the slipping of the wheels when the locomotive is engaged in starting a heavy train. As the wheels commence to revolve beyond a fixed rate the steam supply is instantly cut down by the action of the governor, so as to overcome the difficulty mentioned. As soon as the slipping has ceased the steam supply is automatically increased.

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PHILADELPHIA'S HIGH-PRESSURE FIRE PIPE LINE.

The high-pressure pipe line which has recently been installed to protect what may be termed the "congested district" of Philadelphia consists of four principal supply mains running west, and these four principal mains are connected, to form a gridiron system, by six cross lines running north and south.

One main is provided with three fireboat connections.

A Stream of Water Directed almost Vertically into the Air.

There are 139 specially constructed hydrants on the system, with two outlets at each hydrant for specially constructed 3½-inch hose.

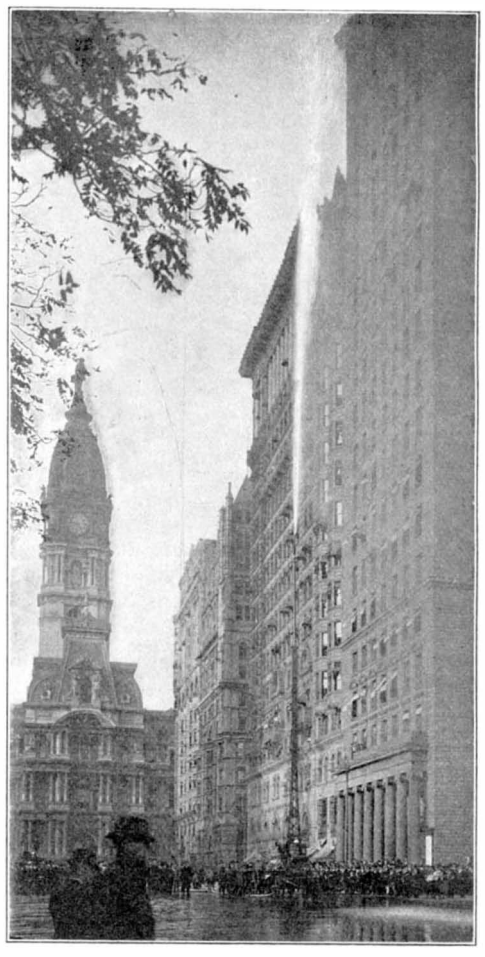
An exhibition was arranged by the committee of the Philadelphia Fire Underwriters' Association, to show the number of effective streams which could be delivered through leads of 300 feet of 2½-inch hose with 1¼-inch nozzles from the static pressure which is to be constantly maintained on the system from the Belmont reservoir without the aid of any fireboat or pump pressure; the number of effective streams which could be obtained under the same conditions but with the aid of the pressure obtained from the fireboats; the effect of substituting 300 feet of 3½-inch hose with 2-inch nozzles instead of 2½-inch hose with 1¼-inch nozzles, under gravity pressure from the reservoir, and also the same under the fireboat pressure; and the results to be obtained by connecting the fireboat pressure with a water tower. The engineering work which made the tests possible is to be credited to the Hoffman Engineering Company, of Philadelphia, to which firm we are indebted for the photographs herewith reproduced.

The exhibition began at the corner of Broad and Sansom Streets, 1½ miles from the Delaware River, as far away as possible from the fireboat connections and where, owing to the elevation, the gravity pressure from the Belmont reservoir would be the minimum. Twelve lengths of 300 feet of 2½-inch fire department hose were connected with two hydrants on Broad Street main by means of three-way connections attached to each of the two outlets of each hydrant, thus having six 2½-inch leads of hose from each hydrant.

The exhibition of the static pressure was interesting, showing as it did the loss of pressure by friction through 300 feet of hose, and how little reliance should be placed on gravity pressures of 70 to 80 pounds at the hydrant when such lengths of hose have to be used.

The pumps of the fireboat "Stuart" were started gradually under a steam pressure of 135 pounds, the water pressure at the pumps rising to 220 pounds in ten minutes, the steam pressure being about 100 pounds at that time. The increased pressure at the pumps seemed to be felt at Broad Street about one minute later and at Race Street in less than that time. With two nozzles open at 3.06, the pressures at the boat being steam, 130 pounds, and water, 100 pounds, the streams were thrown about 70 feet, the nozzles being held at an angle of about 45 degrees. At that time the gages at idle hydrants showed: Race Street, 90 pounds, and Broad Street, 78 pounds. Six nozzles open at 3.12 with pressures at pumps being steam, 100, water, 220; and at idle hydrants, Race Street, 185 pounds, and Broad Street, 165 pounds, threw streams 175 feet at same angle. In the next seven minutes additional streams were opened successively up to twelve, during which time one of the two pumps on the "Stuart" was shut down for repairs. The water pressures at that time ranged as follows: at pump, 140 to 180; at Race Street, 95 to 130; and at Broad Street, 70 to 110; and streams were thrown in increasing numbers from 160 to 130 feet. At 3.20 the pressure from fireboat "Ashbridge" was added and at 3.22 the following water pressure at boats was obtained (the pump on the "Stuart" being again in service), viz.: "Ashbridge," 250; "Stuart," 190; which showed one minute later at Race Street, 175; Broad Street, 155, with twelve streams thrown 175 feet. The opening of the hydrant at 6th and Race Streets discharging through 50 feet of 3½-inch hose with 2-inch nozzle reduced the pressure about 25 pounds at Broad Street with twelve streams thrown about 150 feet (a loss of about 25 feet in distance). At 3.34 the fireboat "Visitor" was also added, and for four minutes water pressures were maintained as follows: "Stuart," 150; "Ashbridge," 220; "Visitor," 140 to 170; twelve streams being thrown about 150 feet, pressures at Race Street being noted at 125 to 130; and at Broad Street, 102 to 109. All boats were then stopped and hose disconnected from hydrants.

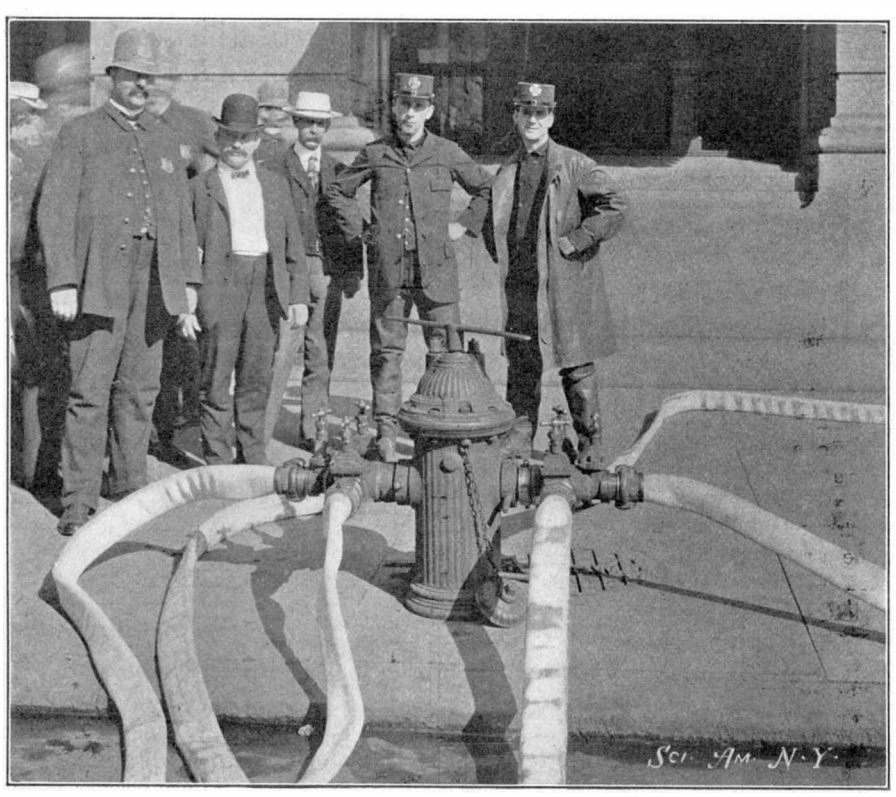
Four 300-foot lengths of 3½-inch hose with 2-inch nozzles were then connected to the same hydrants and one stream opened at 3.56 under gravity pressure from Belmont reservoir only. This stream was thrown 75 feet, the nozzle being at an angle of about 45 degrees and the idle hydrant gages read: Race Street, 60; Broad Street, 55. With two streams in operation water was thrown about 50 feet, the pressure being 53 at Race Street and 47 at Broad Street. When at 4.03 the "Stuart" began to pump into the system and reached a water pressure of 225 pounds with steam pressure of 120 pounds, two streams were forced 230 feet and the hydrant pressures were: Race Street, 200, and Broad Street, 178. At this time the gage at the base of the play-pipe showed 44 pounds, but it is doubtful if this gage was registering correctly, as in view of the streams thrown and the pressures at the hydrants such a showing seems inconsistent. (Experiments made by Mr. S. A. Charles would indicate that the nozzle pressure should have been at least 98.) With



A Water Tower at Work.

from 190 to 195 pounds pressure at the pumps, three of these large streams were thrown 175 feet and four streams 150 feet. With the "Ashbridge" and "Visitor" added these four streams were thrown 190 feet; three streams, 200 feet; two streams, 225 feet; and one stream, 262 feet; the pressures ranging as follows: "Stuart," 210 to 220; "Ashbridge," 260 to 270; "Visitor," 220 to 250; Race Street hydrant, 170 to 210; Broad Street hydrant, 145 to 195; play-pipe, 36 to 50 (doubtful, as explained). While a single stream was being thrown the hydrant at Race Street was opened as before, which reduced pressures at Broad Street about 30 pounds and the length of the stream about 50 feet.

A Hale (largest size) water tower, with a 2-inch nozzle elevated 65 feet above the street, and two 2-inch nozzles on the truck about 4 feet above the pavement, was then connected to the hydrant by two 100-foot leads of 3½-inch hose, and under 200 to 250 pounds water pressure from pumps on the "Stuart" alone, the elevated nozzle threw a horizontal stream about 200 feet and at the same time the two nozzles on the truck threw streams about 250 feet in an angle of about 30 degrees.



One of the Six-Hose Hydrants.

Twelve 2-Inch Streams of Water, Thrown 200 Feet.

PHILADELPHIA'S HIGH-PRESSURE FIRE PIPE LINE.

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A 6,000-TON FLOATING DEPOSITING PONTOON DOCK.

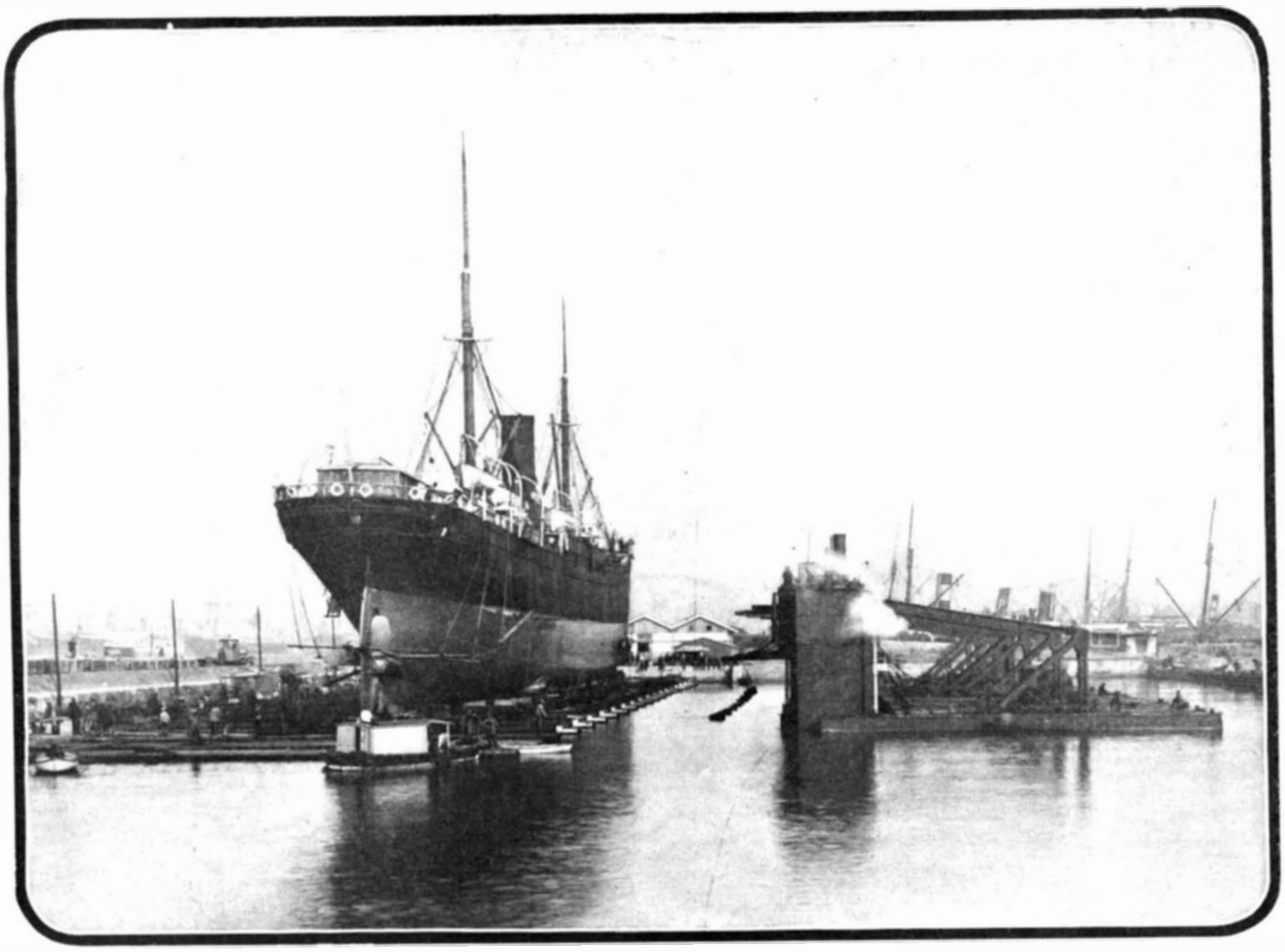
BY OUR ENGLISH CORRESPONDENT.

A very fine example of a floating depositing pontoon dock has recently been completed, and handed over to the port authorities of Barcelona, for utilization at that port. This type of dock differs from those so generally familiar—the two-walled floating pontoon structure as evidenced at Bermuda and Algiers (La.), and the single-sided dock—both in its general design and the functions it has to fulfill. As a matter of fact, the depositing dock is only adapted to those ports where there is either ample vacant, or nearly so, space; where business is not too congested or pressing, and in non-tidal basins. At the same time it possesses several advantages over the graving dock, and if properly cared for is practically as durable.

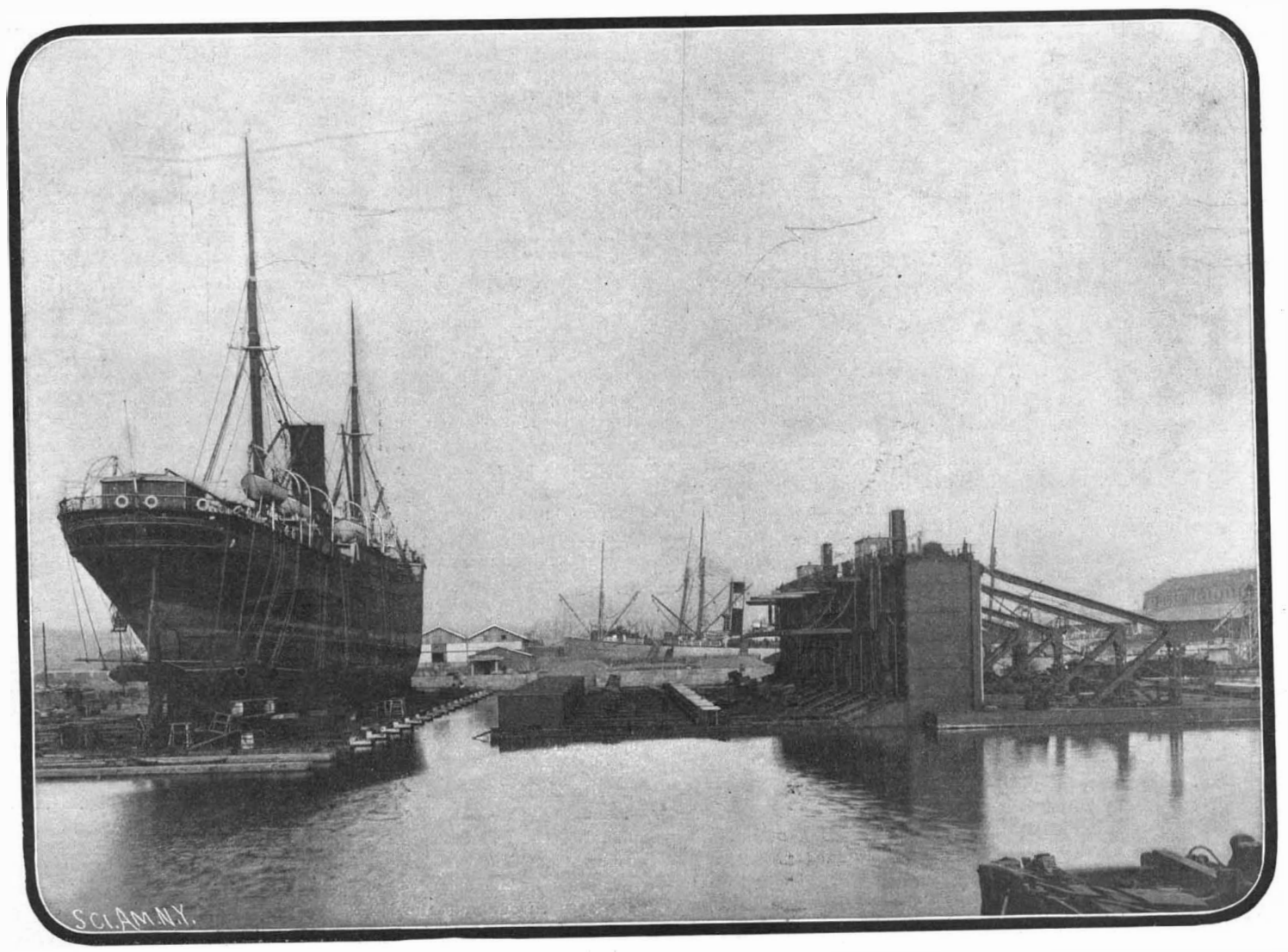
For years past, some description of docking accommodation has been necessary at Barcelona, which is absolutely deficient in any such facilities; but it was not until 1894 that the port authorities took practical steps to provide any adequate arrangements for drydocking large vessels. Several schemes for coping with the difficulty were projected, but they were all abandoned. Finally the problem was solved by the authorities deciding in favor of the depositing dock, invented by Messrs. Clark and Standfield, of 11 Victoria Street, London, who make a speciality of this branch of marine engineering. A public competition was opened for the acquisition of one of the docks, and a number of tenders were submitted. In the following year the result of the competition was announced, and the tender of Messrs. Clark and Standfield, the inventors of the system, was accepted, working in conjunction with the firm of the Maquinista Terrestre et Maritime, of Barcelona, since one of the conditions of the competition was that the dock must be built in Spain.

Although the depositing dock is not much in vogue, types of this system have been in operation with conspicuous success at the shipyard of Messrs. Vickers, Sons & Maxim, of Barrow, England, and at Nicolaieff in Russia for several years past; but neither of these structures approaches the dimensions of the Barcelona dock. That at Barrow has a lifting capacity of only 3,200 tons.

The port of Barcelona is splendidly adapted for the installation of a dock of this type. Anterior to the war with this country it was the focus of the Spanish maritime traffic with Cuba, and the other Hispano possessions in the East; but since the latter have passed under American control, this trade has been diverted into other channels, with the result that the oversea traffic of Barcelona has decreased considerably, and there is consequently not that urgent demand for quay space, and wharf accommodation that there was at the time the depositing dock was projected. Another point in favor of such a dock is that the basin in which the depositing dock is placed is non-tidal.



Ship Docked on Gridiron, Pontoon Sunk and Drawing Clear.



Pontoon Raised, Ready for Another Ship.

The general principle of the design of the floating depositing dock is as follows: There is a wall or vertical side, as in the case of the two-walled type, and it is similarly constructed; but the pontoon of the structure, instead of consisting of a complete base of caissons, extending the whole length of the dock, is built up of a number of separate pontoons, attached only to the vertical wall at one end while the opposite ends are free, the detached pontoons thus projecting longitudinally from the vertical wall, somewhat in the same manner as the fingers of the hand, with equal spaces between. On the foreshore is built a solid structure called a gridiron, the grids of which correspond in length, width, and spaces between, to the fingers of the dock. The result is that when the dock is lowered into position at the gridiron, the fingers of the dock slide between and fill up the spaces between the grids of the gridiron staging.

To the side of the vertical wall of the dock, opposite to that to which the fingers are attached, is a floating outrigger. This supplies the necessary stability to the structure, which, without these outriggers, would heel over, owing to its being one-sided; and furthermore, they serve to counterbalance the weight of a ship raised on the dock.

The gridiron staging is erected along the foreshore.

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The grids are strongly constructed of iron, timber, and concrete. In this particular instance they are built on steel screw piles and are placed 7 feet 10 inches apart. From the description it will be seen that this system of drydocking vessels possesses numerous advantages over the ordinary graving dock. The foreshore can be covered with the gridiron staging on both sides of the harbor, the additions being carried out with greater facility, expediency, and less cost than would be involved in the construction of a drydock.

The dock itself measures 366 feet 11 inches from end to end and has a total lifting capacity of 6,000 tons. It is constructed in three sections each of about 122 feet in length, and 2,000 tons lifting capacity. Only two of these sections, however, will be used in general practice, one being disconnected for the purpose of docking either portion for examination, repair, or renovation. As a matter of fact, it is one of the most salient characteristics of this type of dock with one vertical wall that it can with only the slightest preparation dock itself. The connection of two sections will give the dock a lifting capacity of 4,000 tons, and it will be capable of accommodating vessels up to 300 feet in length. The third section, of 2,000 tons, it is intended to work by itself for dealing with smaller craft, such as coasting vessels, though it will always be in readiness to supplement the lifting capacity of the other and longer dock whenever required, and thus bring the dock up to its maximum lifting capacity of 6,000 tons. The dock when the three sections are bolted up can take a vessel up to 460 feet in length. Hence it is adaptable to a very wide range of vessels, while the ingenious idea of detaching the third section and using it for smaller vessels enables the dock to be always employed. Each section is in reality a complete dock in itself, being equipped with all the necessary pumping and hauling gear. Another very interesting feature of the structure is that supposing vessels of greater length and tonnage than the dock is at present capable of lifting, even when complete, should frequent the port, a further section or sections can easily be added with but little expense.

The dock is situated in a kind of basin or outer harbor almost square in shape. The depositing grids, each 656 feet in length, are ranged on either side of the basin. One grid is intended for the accommodation of vessels of 2,000 tons displacement, and the other up to 6,000 tons. The dock is moored in the center of the basin with the two sections as described placed back to back, and with the pontoons facing the grid staging, the smaller section opposite the lighter grids, which will deal with vessels up to 2,000 tons, and the other dock facing the heavier staging.

The dock is provided with ample machinery for hauling, and gear for traversing the different sections, either together or separately from their moorings to all parts of the depositing grids, the engine power being adequate for the performance of the several operations of lowering the dock, lifting the vessel, and depositing the latter upon the grids in the short period of four hours.

The operation of the dock is simple in the extreme. The vessel to be lifted is towed into the basin and floated over the dock, which has been previously submerged to the requisite depth, by letting water into the pontoons. When the vessel is in the correct position, the water is pumped out of the pontoons in the usual manner, and continued until the vessel is high and dry above water.

The ship's equilibrium is maintained by means of the Clark & Standfield's mechanical side and bilge shores, by the use of which the berthing of a vessel is accomplished quickly and easily. The whole dock is then warped by means of steam capstans broadside on toward the gridiron, the fingers of the dock sliding below the grids. When the fingers have been warped right home, the dock is once more lowered, leaving the vessel high and dry upon the keel blocks on the gridiron. As the dock is submerged, the vessel is still further supported by means of bilge blocks. The dock is lowered until it has cleared the ship, when it is warped out from the gridiron, and again raised and towed back to its moorings in the center of the basin.

Should exigencies demand the drydocking of another vessel while a ship is already berthed upon the gridiron, the dock is pressed into service for this purpose, thus fulfilling the functions of an ordinary floating dock. It will be quite obvious that this system affords a cheap method of providing drydocking accommodations, since the staging may be extended as required by the necessities of the harbor, and two or three vessels may be berthed high and dry upon the gridirons, and another ship may be simultaneously docked upon the dock itself. The raising and docking of a vessel upon the gridiron can be carried out expeditiously, and three or four ships can be berthed in a single day.

The machinery fitted to this dock is sufficient to lift a vessel of the maximum displacement. The dock will raise 6,000 tons in one and a half hours, and in the official trials of the structure the machinery was found to have a considerable margin of power over and above that required.

The illustrations accompanying this article illustrate the several operations of the dock carried out in the official tests by the port authorities of Barcelona. The vessel employed for these trials was the "Ciudad Condal" of the Compañia Transatlantica fleet, and is 40 feet longer than the section of the dock by which she was raised. This will afford a very comprehensive idea of the scope of the work to be achieved by the dock. Another illustration shows the self-docking capabilities of the structure, as one section is raised upon another section of the dock, to enable the underwater portions of the lifted section to be examined. If properly attended to, and periodically examined, this depositing floating dock will last almost if not quite as long as a graving dock, while its serviceability is far wider in range.

Briquetting Precious Mineral Ores.

BY WILLIAM G. IRWIN.

The attempt to reclaim waste materials by the use of compressing machinery, was first developed in Europe, but of late years it has met with marked success in this country. Briquetting, which originally was confined to the compression of fine coal and coal dusts, was begun in Europe as early as 1842, when the first plant was installed at Berard, France, for producing fuel briquettes on a commercial basis. Prior to that time, the matter of making practical use of the vast accumulation of fine coals and coal dust had occasioned much study on the part of the learned scientists of Europe, and since then fuel briquetting has been carried on in various countries on the Continent and in England. The progress of the industry in those countries has resulted in the development of various types of briquetting machinery, and to-day the fuel-briquetting industry abroad is one of considerable value.

As early as 1870 the attention of the anthracite coal producers of Pennsylvania was called to this work, and attempts at briquetting anthracite culm soon followed. A plant of the Lousian process was installed at Port Richmond, Philadelphia, and considerable success was attained; but after several years of operation it was abandoned, because the compressing machinery was not up to the standard required to make the industry a complete success. During the next few years similar plants were installed at Rondout, N. Y., Mahanoy City, Pa., Gayton, Va., and at several other points in this country. In all these early attempts at fuel briquetting, small briquettes, known as "eggettes," were manufactured. These early plants have all been abandoned.

Since that time American inventive genius has been actively at work evolving new briquetting machinery, and as a result, something like one hundred patents on the subject have been allowed by the United States Patent Office during the past twenty years. The manufacture of fuel briquettes is at present of small importance in this country, only two or three plants having been lately established, but the idea of briquetting other forms of minerals has been receiving considerable attention at the hands of American manufacturers. While inventors abroad have been devoting their whole efforts to progress in the compression of mineral fuels, American genius has aimed at reclaiming the precious mineral ore dusts, and, as a consequence, this new industry is now being widely exploited in this country with great success. Many smelting companies have adopted the idea, and are now reaping a decided profit through the smelting of fine ores and flue dusts, which heretofore have not only gone to waste, but have been a decided detriment to the successful smelting of the larger ores.

Some six or eight years ago a smelting company purchased an improved brick press, and began experiments at briquetting fine ores. While this machine was perfectly adapted to brick making, it did not prove a success when put to this new use. However, the attempt showed the feasibility of briquetting mineral dusts, and early promoters of the briquetting industry at once began experiments along this line. After a close study of the European fuel briquetting plants it was found that the complicated system of grinding pans, mixers, elevators, spouts, etc., requisite in brick making, were unnecessary in the briquetting of ore dust, and also that the brick shape was not the best. As a result a combined mixing and briquetting machine was invented, which has given great success in the briquetting of gold, silver, and copper ores throughout the West, during the past five years. This machine was invented in 1896, has undergone many improvements, culminating in the White briquetting press of 1902. It is made in three sizes, the largest of which has a capacity of 100 tons every ten hours. While it is particularly adapted to the briquetting of precious minerals and fuels, it may also, by a system of interchangeable pockets, be applied to the manufacture of fuel briquettes.

The object sought in the briquetting of precious minerals is to treat and compress into the form of small bricks, the fine ores, concentrates, flue dusts and all granulated mineral fines which in their ordinary form do not admit of smelting. In the handling of lump ore a considerable amount of this fine material is lost, and until briquetting was used to prepare such material for smelting, the loss to the smelter owner was considerable. Conservative estimates show that the waste in a modern smeltery ranges from 10 per cent to 20 per cent. The briquetting industry also makes it possible to smelt the slimes from the concentrators, and thereby turn to advantage the valuable deposits which have heretofore been flowing down the tailings. A number of briquetting plants have already been installed for using the tailings which have accumulated in the canyons, or in the settling basins. Old dumps made up of fine ores, flue dusts, etc., carrying mineral values of from 3 per cent to 5 per cent are now being briquetted with considerable success. With the large smelting companies, it is generally conceded that the highest economy lies in getting the greatest amount of refined minerals from the least amount of raw material, and this idea is now being carried out through the briquetting industry.

Aside from the increased production made possible by the operation of briquetting plants, much time and labor are saved by preventing the freezing up and barring down of the smelter; and through the system of utilizing the accumulated flue dusts the operation of the smelting plant can now be conducted on a much more economic basis.

A briquetting plant is usually equipped with automatic delivery apparatus for carrying the briquettes from the machine to the storage bins, where they are dried before going to the smelter. Five men are required to operate a plant of 100 tons capacity. A lime-binding material is generally used, although some of the western ores require no binding material, since they contain just the proper amount of silicious material necessary to form a perfect briquette. Where a binding material is required, a set of two lime slakers forms a part of the briquetting plant. These communicate with the hollow middle casting through large openings at the bottom, a cut-off gate being arranged at each of these openings, which is operated from the platform above. These slakers are driven independently by tight and loose pulleys, belt shifters being operated from the lime floor above. Either slaker may be started or stopped independently of the other. The lime pump is driven by a chain from one of the mixer shafts, its stroke being regulated by a rod and hand wheel. The minerals to be briquetted are fed through an opening in the dust floor, their flow being automatically regulated. After being thoroughly mixed with the binding material, the fine minerals go to the press where the briquette is formed, and a series of belt conveyors carry the compressed briquettes to the storage bins. All the machinery of the plant is controlled by one man.

One of the early difficulties experienced in the manufacture of mineral briquettes, and fuel briquettes as well, was the lack of power exerted by the press. This difficulty has been removed through late improvements. The earlier methods of putting the briquettes through the smelter in their green form, have been abolished, and at present they are thoroughly dried before being smelted. Briquettes can now be made from fine mineral ores and flue dusts at a cost of less than sixty-five cents per ton, and some idea of the value of this industry in the smelting of fine mineral ores will be realized when one considers the vast wastes which have long accumulated in smelting operations.

In this important application of briquetting machinery is seen another apt illustration of the alacrity with which American genius adapts old principles to new requirements. While briquetting machinery for the compression of mineral fuels has been going on in Europe for more than fifty years, it remained for Americans to undertake the briquetting of fine ores, and to-day American ore briquetting machinery is in operation in Australia, South Africa, and other foreign countries. At the same time attention is now being given to the briquetting of coal dust and several new ideas are being worked out by the promoters of briquetting machinery in this country.

The State of Pennsylvania and the United States Geological Survey have co-operated in the production of some very detailed maps of the western part of the State, a section which includes a greater amount of industrial activity than is to be found centered anywhere else in the country. The map will be made to a scale of about one mile to 2½ inches, and it will be possible to show the ground plan of the more important buildings in point of size, the location of all water and oil tanks and railroad tracks. From this map the Chamber of Commerce of Pittsburg will have a model of the city made for exhibition at the Louisiana Purchase Exposition. This will be complete in all its details, and will accurately show all the industrial features of the city.

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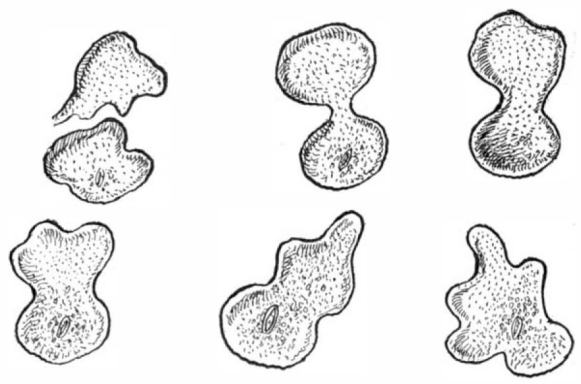
THE AMŒBA—A SLIME MONSTER AND ITS VICTIM.

BY J. CARTER BEARD.

The other day, when amusing myself with my microscope, a catastrophe occurred in the field of vision, which is quite equal in its tragic elements to, and much more wonderful than, anything I have ever seen without the aid of my instrument.

I had under inspection something that looked like



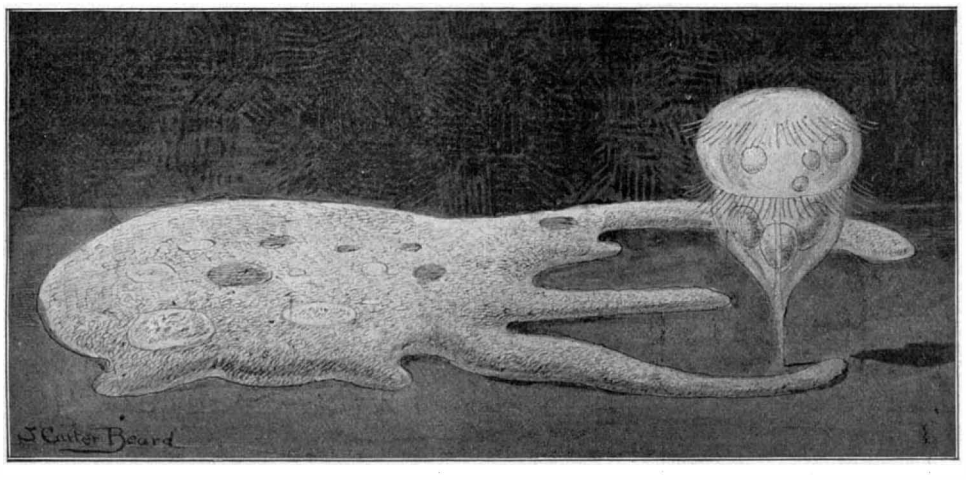
AMŒBA, SHOWING SIX CHANGES DURING THE PROCESS OF FUSION.

a bit of slime. It had neither head, body, nor limbs, nor any division of parts. It had no more apparent organization than the drop of slime or jelly it so much resembled; yet it without doubt possessed animal life, and power of movement.

It is called the amœba, and is probably one of the strangest objects in existence. As I watched it through the glass it began to progress slowly in one direction. Instead of crawling like a worm or a snail or creeping like an insect, it simply *flows;* being a sort of liquid animal. No other word can express its motion. First it throws out projections or false limbs or feet, as they are called. This it can do in any given number and from any part of its substance. Then it ran its entire substance into these projections. Having collected itself, with a more literal reference to the meaning of the term than that in which it is commonly used, the amœba is ready to repeat the process and advance another step. Perhaps the nearest and best illustration of how this is managed is furnished by a bit of water making its way down the inclined lid of a desk; the small currents or splashes it sends ahead of the main body answer to the pseudopodia or false feet of the amœba, and its alternate filling up of these small channels and its bursting forth and sending out new ones almost exactly parallel the progress of the animal. There is this difference, however—liquid can move only down inclined surfaces, while the amœba is enabled by some incomprehensible agency to move along level or even ascend inclined planes.

The creature has no heart, brains, blood, nervous system, or muscles, and yet it seeks, pursues, and captures and devours its prey, and seems to have a mind and will of its own, and to enjoy life fully.

As I was watching the ever-changing shapes assumed by the amœba in its progress, my attention was called to an object close at hand which I had not before noticed. This was the most delicate, fairy-like little sylph it is possible to imagine—a sort of a living top or iridescent crystal, flashing prismatic rays as if it inclosed a tiny rainbow, as it stood spinning in the water backward and forward on its stem. I knew it for a urocentrum, a more highly organized animal, if



HIGHLY MAGNIFIED AMŒBA PROTEUS WITH PSEUDOPODIA ADVANCED ENCIRCLING AN UNUSUALLY LARGE SPECIMEN OF UROCENTRUM TURBO.

that term is applicable in contrasting it with an animal like the amœba with no organism at all.

I watched the slime monster with redoubled interest. It was certainly gliding along in the direction of the fairy top. How it was conscious, without ears to hear, eyes to see, or nostrils to smell, of the presence of the urocentrum, I must leave to far more learned and capable physiologists to make intelligible. I cannot even suggest an explanation. It was sufficiently evident that the urocentrum *was* its point of attack. There could no longer be any doubt. The pseudopodia at last touched the living top; then they encircled it. The urocentrum seemed to be aware of this, and moved restlessly in its prison. After a while, however, as if it received some paralyzing shock, the fairy top ceased to spin; the ends of the pseudopodia are fused together, and the slime monster flowed over and engulfed the litle creature, which is its manner of swallowing its victim. Thus having pursued its prey without the aid of limbs, and devoured it without a mouth, the amœba proceeded to digest it, although stomachless.

If anything related to the animal can be stranger than the peculiarities embodied in the foregoing narration, it is to be found in the complete breaking up of one animal and the production thereby of a number of baby amœbæ, which when united formed the parent. When this remarkable change is about to happen, the amœba ceases to move or take food, and forms about itself a thick shell or covering. As an egg hatches the shell bursts, and the amœba is found to have resolved itself into a number of little balls, each ball a perfect amœba, and quite able to set up in business for itself. Stranger still, they sometimes conclude to unite forces, and by coalescing or flowing together, again become an animal.

Fighting Insect Pests.

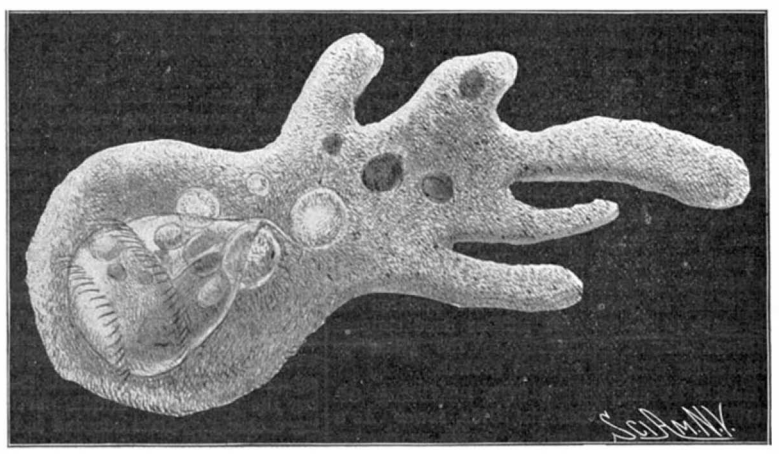
BY CHARLES F. HOLDER.

The stranger passing through the ranch country of Southern California is frequently puzzled by the singular "outfits" which are seen. Some resemble old-fashioned fire engines; others, wagons bearing derricks. Trees are seen covered by tents. A ranch hand vigorously works a hand-pump, while another directs a nozzle at a tree, apparently painting it after the modern fashion. All these notably dissimilar appliances are the attempts of the orange, lemon, olive, and other fruit growers successfully to fight the scale and various pests that make war against trees. That a vigorous and relenting warfare is necessary, every fruitman or orchardist well knows.

Every plant of value to man appears to have its enemy, and not merely one but many, and expert skill is required not only to combat the enemy, but to discover some enemy to aid in the battle. When the mission fathers introduced the olive, they soon discovered an enemy whose very existence they had not previously noticed. This was the black scale, *Lecanium olea*, the insect which resembles an excrescence on the limbs, and which would hardly be recognized as an insect, so inconspicuous is it. Dark and rounded on the top, only when it is turned over is it noticed that it is a living creature. The black scale is so slow of motion that apparently it does not move, but it increases with a rapidity that is appalling to the orchardist. The common name of scale is given to several insects, the black, white and red scales being the best known. They belong to the family *Coccidæ*, and are bugs provided with sucking organs with which they draw upon the vitality the tree. The long scale, *Mytilaspis gloveri*, was probably brought from China, and appeared in Florida in 1838, and though persistently fought, it is found on lemon and orange trees of Florida to-day. In 1890 it was discovered in California, being brought to this region with the purple scale which is found in all orange or lemon groves. It is a disagreeable scalelike creature which multiplies with great rapidity, the young thrusting the proboscis into the tender branch and immediately beginning to exude a waxlike substance, which as it accumulates adds greatly to the size of the insect. The effect of the black and purple scales is not to kill the tree, but to seemingly paralyze it. Several trees affected in the writer's grounds have not flowered and are at a standstill.

The red scale, *Aspidiotus*, is almost equally dreaded, affecting the leaves of plants. The Florida scale, *Icerya*, some years ago almost ruined the orange industry of Southern California. Trees were so covered with the scale that they had the appearance of having snow upon them. Then there are the white fly, the red spider, and many other insects, suckers and borers, which prey upon the trees and make the life of the orchardist miserable. To stay the ravages of these enemies the genius of the rancher is called into play, and as a result we have singular vehicles and curious pumps and tents. Everything that the ingenuity of man could suggest was tried upon the cottony scales without avail until Mr. Albert Koebele, of the Department of Entomology, discovered the natural enemy of this pest in the twice-stabbed ladybird of Australia. This little insect was introduced, and in a marvelously short time practically exterminated the dreaded white scale, and the orange groves of California took on a new growth. But the black and other scales still flourish, and no deadly enemy has been found for them; instead, the rancher attacks them with various sprays and poisons.

In one method of extermination, the tree is covered with a bag or balloon of canvas. The derricks for lifting the canvas are placed on a heavy truck or dray, and driven to the side of the affected tree; the bag is lowered over it and the space filled with a chemical produced by the combination of ninety-eight per cent of potassium cyanide, sixty-six per cent of commercial sulphuric acid and water. This work is now systematized, and in the hands of companies, and with many large tents, some seventy feet in diameter, they treat tree after tree in a rapid manner. If this is done in summer, it is of little use, as the eggs are not destroyed except in rare instances; but in October or November, when the young are all out, this method is very effective. The engine-like appliances seen in the groves are for spraying trees and consist of a pump worked by one or two men, and a reservoir large enough to contain several gallons of "distillate." The hose



HIGHLY MAGNIFIED AMŒBA PROTEUS WITH A LARGE UROCENTRUM TURBO IN DISTENDED HINDER PART.

is mounted with a long nozzle, by which the men can reach every part of the tree, and is more or less effective, but will not, as a rule, destroy the eggs. The washes are of various kinds. One of the most effective is an emulsion of crude kerosene, whale-oil soap, and water, costing when made ten or twelve cents per gallon. Another effective spray is resin wash, made of resin, caustic soda, fish oil, and water. This is forced up under the limbs and leaves, and literally covers the tree and all its parts, killing the various insects as it runs down. But so tenacious of life are the latter, that often several treatments are necessary.

How the trees are covered with tents and how they are sprayed with pumps is shown in the illustrations accompanying the article on "Orange Culture in California," published in the SCIENTIFIC AMERICAN for February 21, 1903.

An Early Advertisement of Jenner's Vaccine.

A little more than a hundred years ago Dr. Jenner announced his discovery of vaccination as an alleviator of smallpox.

The following is a verbatim copy of that call published in the London Times which was signed by about one hundred of the medical profession, scientists, members of Parliament, and the nobility:

London, January 10, 1803.

The invaluable Discovery of Dr. Jenner, for the Extermination of the SMALL POX, having undergone the most rigorous investigation, and received the sanction of Parliament, a MEETING will be held at the London Tavern, Bishopsgate-street, on Wednesday, the 19th inst., at 12 o'clock, to consider of the best means of carrying the same into effect; when the company of every Gentleman disposed to concur in this laudable Undertaking is earnestly requested. The Chair will be taken, by the LORD MAYOR, precisely at one o'clock.

One of our correspondents recently passed through a peculiar experience. He tasted of a small fraction of a grain of radium. It acted as a powerful stimulant, affecting both the heart and kidneys. It was several hours before his pulse became normal. It affected the mind also, producing hallucinations.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PLOW.—T. H. HARRIS, Fredricksburg, Va. This is an implement by which the land-furrow may be turned in either direction, by which the depth of the furrow may be regulated as well as the width and in which the disk can be lifted for passing over stones and other obstructions and in moving from place to place, and in the use of which the driver can adjust the plow from the driver's seat and begin work as soon as the team is in position. The axle may be long enough to support two or more disks.

HARROW ATTACHMENT FOR PLOWS.—J. C. FOOSHE, Ninetysix, S. C. The purpose in this invention is to provide connected spiked-wheels, a support upon which the wheels are mounted to turn, and means for adjustably connecting the support to the plow, whereby the support may be placed and held at any angle to the beam, whereby as the plow advances the spikes strike the ground obliquely to the rows of plants, causing the spiked teeth when operating across a row of young plants to thin them out, and supplying room for the growth of the remaining plants. At the same time young weeds are removed, the ground pulverized to the roots of the plants, and the ground turned up by the plowshare.

CANE-LOADER.—L. B. LOTZ, Plaquemine, La. In loading sugar-cane the cut cane having been thrown four rows in one, thus leaving two clear rows for the loader to move in, the device is drawn along the row of cane. The open grab-hook being lowered over the cane and so placed as to grab an armful is operated by means of a hoisting-rope to raise the cane, when by means of a handle the operator turns the bundle held by the hook to a point over a wagon, when the hooks are tripped to deliver the cane.

BUTTER FOR HARVESTERS.—J. J. WISEMAN, Wunghnu, Victoria, Australia. This apparatus is constructed in two sections—a feed section and a butt-alining section. Means are provided for adjusting the butter in such manner that the alining-section no matter in what position the butter is placed will be parallel with the packers and will produce a straight butt for the sheaf whether the grain be long or short. The contrivance materially assists in keeping the binding-table clear, thus preventing the grain choking between the rollers and packers of the harvester.

PLANT-SUPPORT.—E. C. SHERMAN, Lawrence, N. Y. The inventor's object is to provide a plant-support, easily applied, and arranged to securely hold the stems or other parts of the plant in proper and secure position on the stake, wire, or other similar fixed support without danger of injury to the plant or interfering with its natural growth.

RAKE ATTACHMENT FOR REAPERS OR MOWERS.—G. HAUENSTEIN, Olds, Iowa. As a substitute for a reel upon a reaper or mower, the inventor provides a rake whereby the grain will be drawn to the cutter-bar and over the platform at the rear thereof no matter whether the grain is upright or inclined more or less in direction of the ground. The rake is supported so that it will have a rotary reciprocating motion over the grain-receiving platform and over and in advance of the cutter-bar. The rake is so supported and located that it may be driven by the same gearing usually employed to impart motion to the reel.

DRAFT AND STEERING DEVICE.—H. J. EIFLER and G. A. NAUMAN, Oxnard, Cal. The design in this case is to provide a draft and steering mechanism so connected to a plow that the plow-beam is relieved of all strain except a light lateral strain, thus making it more durable, and, further, to so arrange the mechanism that the steering may be accomplished with very little manual exertion.

Dental Apparatus.

PNEUMATIC APPARATUS FOR DENTISTS OR PHYSICIANS.—P. H. STEHLEY and J. H. HULINGS, Parsons, W. Va. The improvement designed by these inventors consists in a novel construction and arrangement of pneumatic reservoir for air in combination with a receptacle for medicaments and various pipe connections, tubes and nozzles, whereby the apparatus is made available for the uses named in a simple and convenient way. It is applicable for use by chemists, embalmers, and others.

ATTACHMENT FOR DENTAL ENGINES.—J. C. HOLSON, Ord, Neb. In the present case the improvement resides in an attachment engageable with the barrel of an ordinary dental engine and comprising a nozzle connected with the water source and certain means for manually controlling the movement of the water from the nozzle, so that the dentist may turn the water on or off at will by an easy operation of the same hand which holds the tool.

Engineering Improvements.

GAS-ENGINE REVERSING-GEAR.—M. H. NEFF, Watertown, N. Y. The igniter in this reversing-gear on being actuated by an eccentric on the engine-shaft, is moved so that its position on the shaft is changed, thus changing the moment of action of the igniter so as to "catch the engine on the turn," and thus reverse its movement.

PUMP.—A. DELLANNA, Salt Lake City, Utah. Mr. Dellanna's invention relates to a pump, the general characteristic of which is one or more cylinders moving on relatively stationary pistons and adapted to be submerged in a body of water to force a column through a discharge-pipe.

VALVE.—R. A. QUIN, Shamokin, Pa. This valve is of that class that requires to be acid-proof internally; and the inventor's object is to provide a new and improved device which is simple and durable in construction and completely acid-proof to permit its use for the passage of mine or acid waters, to insure long life of the valve, and at the same time prevent leaking.

PUMPING SYSTEM.—J. G. STEINER, Bluffton, Ohio. In this case the improvement pertains to a system or apparatus for operating pumps and other machinery by fluid-pressure, the aim being to transmit power from a central station to a plurality of pumps situated at different points, this power being transmitted by the fluid-pressure referred to.

HYDRAULIC RAM.—H. CULPAN, Aims, Ore. The object of the invention is the provision of a new and improved ram which is simple and durable in construction, very effective in operation, and arranged to produce a greater ratio between the head of power-water and the head against which water is discharged.

Hardware and Tools.

WIRE-FENCE-BUILDING IMPLEMENT.—E. F. HALL, Hayes, Texas. The object of the inventor is to provide a novel implement adapted to take up slack in an unbroken fence-wire, draw together ends of a broken fence-wire, so as to permit the ends to be spliced together, cut off surplus wire, and pull staples from the fence-posts.

DOOR-LOCK.—C. ASHMUSEN, Kings Park, N. Y. The door-lock in this case can be readily changed from a spring-lock to a dead-lock, and vice versa, is not liable to be opened by unauthorized persons or unscrewed to give access to the mechanism, and is arranged with the lock mechanism contained in the door-knob and adapted to be unlocked either from the outside by a key in the outer door-knob or from the inside by a push-button on the inner door-knob.

SHEEP-SHEARS.—H. BURGON, 136 Oakbrook road, Sheffield, England. This sheep-shears improvement relates to hand-operated shears whereof the blades are connected by shanks or handles to a spring-bow; and the object of the invention is to obtain the desired advantages of interchangeability of the blades and avoid all torsional weakness of the connections consequent on the detachability of the blades.

PICK.—J. L. GRIFFIN, Wellsville, Ohio. The construction of this pick is such that the helve may be securely fastened therein without being weakened, and it may be readily removed and replaced by a new one. This is done by recessing the pick at its middle portion and providing a clamping-plate adapted to be fastened over the recess, the recess being of dovetail form, so that when the helve of corresponding shape is fastened therein the parts cannot become separated while the pick is in use.

BORING-TOOL.—C. K. SHEETS and W. L. HILL, Montgomery City, Mo. The advantage of this tool over similar ones is that a bung-hole may be bored in a barrel without liability of shavings getting therein. The cutting-lip on one blade is a little longer than that on the other blade. When the tool is in use the lip on the blade will be the first to cut through the barrel, forming a loose plug and arresting further boring action of the shaving edges. An outer annular ledge is left on the plug, and when the plug is lifted the advantage mentioned above is obtained.

Heating and Lighting Apparatus.

CARBURETER.—D. J. ESSER, Mauch Chunk, Pa. The end attained in this invention, is the provision of a new carbureter not liable to get out of order, perfectly safe, and arranged to effectively purify and enrich the gas to insure burning thereof with great economy and with a bright and clear light.

HEATER ATTACHMENT.—G. LUND, Victoria, Canada. In this gas-stove the object is to provide a new and improved heater attachment for gas heating and cooking stoves arranged to carry all obnoxious gases out of a room, and at the same time utilize the heat to the fullest advantage for heating water and air in the room.

SMELTING-FURNACE.—E. CAMPBELL, Rossland, Canada. In Mr. Campbell's apparatus the improvement relates particularly to the water-jacketing construction of the furnace and to the novel construction of the receiver, including the tapping-jacket and slag-spout. The inventor aims to construct the furnace of wrought-iron, replacing all cast-iron water-jackets, rings, etc., with flanged wrought-iron jackets and to avoid seams and rivets where molten metal comes in direct contact therewith.

CUPOLA.—T. HOLLAND, New York, N. Y. This invention relates to improvements in furnace-cupolas for melting metals, the particular object of the inventor being to provide a simple means for introducing hot-air blasts into the cupola to quickly raise and maintain a uniform temperature of very high degree.

WATER-HEATER.—T. E. LEACH, Brooklyn, N. Y. The purpose of this invention is to provide a device for heating water in bath-tubs, and other receptacles through the medium of gas, gasoline, or other vapors and to so construct the device that it will be quickly and conveniently applied and held in position, and adjusted to any depth of receptacle. Another purpose is to so locate the water-circulating tubes that the heat will be circulated around and in engagement with them for a maximum period before escaping.

Mechanical Devices.

DEVICE FOR GRINDING BROKEN PAPER.—R. DIETRICH, Merseburg, Prussia, Germany. Suitable for the perfect combination and grinding of so-called "broken" paper, cellulose, ground wood, and similar material for the manufacture of paper, this kneading and mixing machine is superior to the devices of this kind as heretofore employed, by the chips of the paper being caught and pulled into the device with reliability, so that an abundance of good and uniform pulp can be obtained in a short time ready to go on the paper-machine.

COTTON-CLEANER.—E. B. HAM, Jennings, Oklahoma Ter. The contrivance invented by Mr. Ham relates to an improvement in cotton-cleaners and consists of novel construction and combination of parts of which the object in view is the production of a cheap, simple, durable and efficient cleaner that may be used either in connection with an unloader or with the gin-house suction.

OVERFLOW-ALARM.—G. H. ROWLAND, New York, N. Y. The invention in this case refers to over-flow alarms, the same being adapted for use in refrigerator-pans to automatically indicate the accumulation of water therein up to a certain level and to notify a housekeeper that the pan requires attention, thus preventing the overflow of water and damage to carpets, etc. It may be used in any kind of a receptacle to indicate the rise of liquid to a predetermined level.

GLASS-MOLDING MACHINE.—S. KRIBS, New York, N. Y. A leading feature of this machine is the construction which enables a double insulator to be formed, that is, an insulator carrying two wires so formed that a reëntrant cavity lies between the two wires, to prevent short circuiting the wires from sleet or rain. Another feature lies in handling a core used to mold threads on the interior of the insulator, in such a manner as to prevent stripping the threads. Another feature lies in the arrangement of a plurality of molds and an equal number of plungers so that they all work successively, giving time to cool the parts.

METAL-SHEARS.—T. F. LIPPENGOOD, Libertyville, Iowa. The object in view in this invention is to provide a simple and convenient metal-shears adapted to be used either by hand or by power and which may be easily changed from right to left hand cutting, and which by having two cutting edges for the movable blade shall be capable of running for a long time without regrinding.

GRAIN-ELEVATOR.—C. R. BENEDICT, Lidgerwood, N. D. The class of grain-elevators to which the improvement in this invention has reference is that having an endless chain of buckets, the object being to provide a simple means for automatically cutting off the supply of grain after a certain amount shall have passed into the elevator, and thus prevent choking of the buckets while running at full speed.

COTTON-GIN.—J. BRANDON, New York, N. Y. The inventor claims as his object in this improvement a new and perfected cotton-gin for readily ginning cotton, the mechanism assuring a uniform pull or tension upon the cotton fibers throughout their entire length, thus preventing kinking, and thus entirely diminishing the possibility of injuring the staple by adhesion.

SAW-SETTING MACHINE.—B. F. BRILEY, Bluff City, Kan. The intention in this case is to provide a saw-setting machine, very effective in operation, and arranged to periodically feed a saw-blade forward the distance between three teeth to bring a tooth in position for a setting hammer to strike the tooth and accuraely set it to any degree, according to the fineness or coarseness of the saw.

DREDGER.—F. W. THUNEN and L. L. CHESHIRE, Oroville, Cal. This type of dredger is useful for mining operations. The inventors have particularly in view the provision of cutting or digging mechanism for the dredger, which shall be so constructed that stones and the like will be prevented from entering the space between the teeth or body of the digger and the side of the support upon which the diggers are mounted, thus obviating the possibility of breaking or damaging the cutting-teeth of the diggers. Means are provided for removing worn-out teeth and substituting new ones.

CASH-REGISTER.—JOHANN C. VAHJEN, New York, N. Y. This machine can be quickly operated and a check and duplicate check be obtained. The check proper is automatically delivered from the device while the duplicate check will remain locked in the machine to be examined whenever opened. Amounts indicated can be read at the front and at the back of the machine; and means are provided to detect any omission to ring up a sale and to identify the salesman; also means to produce display matter on the check delivered, which check is evidence of a sale recorded and as a protection against an overcharge.

STONE-BREAKER.—E. DEANE, New York, N. Y. The improvements in this case reside especially in the means for imparting movement to a movable jaw; and they consist in a crank-shaft carrying a pitman which hangs from the crank-shaft and is of rectangular form, the lower portion being in the form of a horizontal bar which coacts with a toggle, so that as the pitman is raised and lowered the toggle is actuated to impart the necessary movement to the movable jaw. A bearing block for the shaft on which the movable jaw is mounted enables the shaft to be adjusted toward and from the stationary jaw at will, thus to regulate the degree to which stone is to be crushed.

Medical Devices.

SYRINGE.—F. M. BAKER, Fond du Lac, Wis. The prime object of this invention is to so construct the syringe that the proper surgical cleanliness will be insured, thus avoiding all possibility of the presence of poisonous foreign matter. This device will be constructed and assembled in the laboratory and placed in a sterilized package, where it is kept until used. When taken from the package, the needle should be inserted under the skin, and the two friable portions of the receiver fractured, after which upon operating the bulb the liquid may be ejected without being exposed to the air or being brought into contact with operating fingers.

Musical Instruments.

STRINGED MUSICAL INSTRUMENTS.—H. STEENBOCK, New York, N. Y. Following on a former patent granted to this inventor relating to zithers and like instruments, the present invention has for its aim the provision of a stringed musical instrument arranged to allow hammers to strike the strings from underneath with any desired force and without danger of dislocating the strings and without causing the instrument to get easily out of tune.

MUSICAL INSTRUMENT.—J. CONNERY, Corning, N. Y. The arrangement of this simply and durably constructed instrument enables a player to sound the strings or other sounding devices in a very simple and effective manner on the performer actuating the corresponding keys of a keyboard. The driver-wheel may if desired be driven by mechanical or other means.

Railway Improvements.

SAND-GUARD FOR RAILROAD-TRACKS.—J. P. NEWELL, Portland, Ore. Stated broadly, this improvement consists in a novel guard fence or wall intended to be set at an angle with the prevailing winds and between the track and the approaching sand drifts, adapted to catch the wind and turn it downward with added force to divert the moving sand, which, with the diverted wind, will be carried along in a direction parallel with the guard front and deposited where further drifting can do no harm. The action is the same with drifting snow.

COMBINED TRACK-SWITCH AND BLOCK-SIGNAL.—H. HOLLIS, Wilmington, Del. This is an invention which pertains to track-switch mechanism together with block-signals to be used in connection therewith. It can be used in a great variety of relations, but is particularly applicable for service in street-car systems in cities in which a single track is used, when cars passing in opposite directions cause loss of time at points from which the track is visible for only a short distance.

RAILWAY CONSTRUCTION.—P. DUNWALD, Rio, N. Y. The aim of this invention, which refers to passenger transportation is to provide a new and improved railway construction which is simple and durable and more especially designed for conveniently and quickly transporting persons up and down streets in cities and other places.

Vehicles and Their Accessories.

DUMPING-WAGON.—V. BROWN, Watrous, New Mex. Mr. Brown is the inventor of an improved dumping wagon the body of which is adapted to be tilted to one side when dumping. When the body is thus tilted a simple means is automatically actuated to lift up the lower side-board of the body, permitting the contents to fall out.

SHIFTING-RAIL FASTENER FOR VEHICLE-TOPS.—F. H. DELKER, Henderson, Ky. Provision is made by this invention for the quick reliable connection of the shifting rail of a vehicle-top with the seat-irons or braces that are fixtures on the side and backboards of the vehicle-seat, and likewise the convenient and speedy removal of the vehicle-top from the seat, as occasion may require.

FIFTH-WHEEL.—J. BURNS, Brooklyn, N. Y. The design in this case is to construct a new and improved fifth wheel which will not only reduce the friction attending the movement of the parts, but will also provide a device which may be kept clean and which will avoid the unsightly appearance common to fifth-wheels of the usual construction.

AXLE.—E. A. JUDD, Olean, N. Y. The invention relates to thimble-skein axles used on farm and lumber wagons; and the object is to provide a new and improved axle which is simple and durable in construction, exceedingly strong, and arranged to resist the tendency to spring under a heavy load.

Another invention relating to thimble-skein axles such as described above has just been patented by Mr. Judd, and its purpose is to provide a new and improved axle which is cheap to manufacture, and arranged to obviate the use of special fastening devices for securing the reinforce bar in position in the axle-tree and thimble.

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WHEEL-FASTENER AND AXLE-PROTECTOR.—G. WOOD, Ballard, Wash. The purpose of this contrivance is to provide a construction whereby to quickly place and hold a wheel-hub upon an axle spindle without the use of a nut, the wheel being fastened from the rear instead of from the front, and to provide perfect protection for the end of the axle against sand, dust, etc. Means are supplied for bringing the front projection of the hub practically within the plane of the dish of a wheel.

Miscellaneous.

BAKER'S OVEN.—G. H. MCCAUSLAND, Philadelphia, Pa. In this case the object in view is the provision of means by which the oven-door may be quickly opened to introduce or remove loaves or the like into or from the oven-chamber, the door being closed in a similar manner in order to confine the heat in the chamber, the whole operation being done with less time, labor, and loss of heat than by the common method, which requires the door to be operated by hand.

BARREL-HEAD FASTENER.—H. H. KROMBERG, New York, N. Y. The purpose of this invention is to provide a device adapted to receive the chime or end sections of staves and in which the customary head may be readily laid and fastened, and, further, to so construct the device that any person of ordinary intelligence may place a head in position and remove it without injury to the contents of the barrel no matter how fragile. The device permits the heads to sustain great weight without sagging and adds materially to the barrel's strength.

BREWING.—H. A. HOBSON, 54 Church road, Acton, London, England. Mr. Hobson previously invented a method of brewing in which a hopped wort was produced by first making an infusion of hops, then running it off, and after fixing the tannic acid extracted from the hops mashing malt in the hop decoction as the mashing liquor. In the present invention the especial object is to effect an economy in working such process by extracting to the utmost extent the useful properties retained by the materials treated and making them available in the production of the wort.

MILK HEATER OR COOLER.—A. JENSEN, Topeka, Kan. This device provides means for heating, cooling, deodorizing, and aerating milk and other liquids. When milk is to be heated steam is introduced which sets up circulating currents and gradually heats the liquid flowing in a thin film over the outer surface of a conical wall. If to be cooled, a stream of cold water is introduced from the bottom of the conical pan and absorbs the heat of the milk.

CHECK-HOOK.—J. H. ALLISON, New Vienna, Ohio. This check-hook is so constructed that when a rein is held in by the hook it cannot be displaced, but the rein may be readily dropped forward after being separated from the hook a sufficient distance to allow the animal freedom to drink and move his head to and from his sides, and then by one movement of the hand the check-rein may be again carried to checking position on the hook.

COOLER.—C. F. CONOVER, New York, N. Y. This cooler is designed for cooling distilled aerated mineral waters and liquids usually contained in a large receptacle adapted to be supported on the cooler and tilted to allow emptying of all its contents and to permit quick connection between the receptacle and the cooler proper to insure a flow from the receptacle through the cooler whenever a discharge-faucet is opened.

SKIRT-HOLDER.—S. D. ENGLE, Hazleton, Pa. Mr. Engle has in view the provision of a simple article for holding women's skirts from dragging, thus relieving the user of the labor of holding up the skirt by hand. It may be used with any kind of a skirt made of thick or thin fabrics and it is operated by frictional engagement of its parts with the dress fabrics, so as to overcome any liability of injury thereto.

HYGROMETER.—J. H. GERRER, Elreno, Oklahoma Ter. This device is of that character which employs signal-flags and a dial and indicator-hand in connection with a twisted strip or string having one end free and the other fixed against movement. The strip or string must be formed of material that will expand or contract to atmospheric conditions, thereby twisting or untwisting its free end, to which end the flag-support and the indicator-hand is secured.

AWNING.—H. C. MARCUS, Bohemia, Ore. Comprised in this awning for tunnels is a collapsible frame formed of spring material, so that it may be arched upward and one side edge engaged with the side of a tunnel and the other side engaged either with the opposite side of the tunnel or with an extensible supporting-bar, the awning forming an effective covering for workmen and shedding water to the very sides of the tunnel.

MEANS FOR FIXING BOLTS, SCREWS, OR SIMILAR ARTICLES IN SOFT SUBSTANCES, SUCH AS WOOD.—J. V. E. THIOLLIER, 58 Rue de Lourmel, Paris, France. The system invented by Mr. Thiollier consists in placing between bolts and the sides of a hole in a piece of wood with which the bolt is to be engaged a metal protection consisting of a band or rod of metal wound into a coil. The chair bolt or screw is thus enveloped throughout its length, or almost so, by the coil. Under these conditions it is no longer the bolt or screw which is in contact with the wood, but the coil of metal, whose hold on the wood is determined by the impulse to expand, which it receives from the inserted screw or bolt.

SHADE-HANGER.—W. DISNEY, Cincinnati, Ohio. The improvement in this patent relates to shade-hangers for windows, the inventor's object being more particularly to produce an adjustable hanger and to prevent the free ends thereof from wearing upon the woodwork of the window. In this shade the usual support is not needed, the pressure of a cord being all the support required.

BUCKSAW.—C. T. REDFIELD, Glenhaven, N. Y. Mr. Redfield in this device has made an improvement in buck-saws; and it consists in a novel construction and combination of parts whereby the saw-frame can be strongly braced so that it cannot rack on the joints, will always remain in perfect alinement, and will be rigid in use without any danger of breaking.

PHOTOGRAPHIC MOUNTING-ROLLER. J. H. HAMPP, New York, N. Y. One object in this case is the provision of means for imparting a traveling motion to a pressure-roller, so as to make it traverse the work on a bed of the apparatus, the mechanism being autoreversible and arranged to clear the driving and idler pinions of the sprocket-gear-driving mechanism. Another is to provide means for raising the roller with relation to the bed in order that the work may be placed in position beneath the roller, certain of the roller-operating devices being arranged to permit of its adjustment by the lifting devices.

UNIVERSAL FRACTION RULE OR SCALE. W. F. LEAVELL, Castlerock, Wash. This invention has for its object the provision of a device by means of which all the fractions of an inch not usually found on an ordinary rule may be readily obtained, while at the same time the ordinary linear scale-measure may be used on the same instrument.

DRAWING-FRAME.—L. J. WRIGLEY, Lawrence, Mass. The present improvement has reference to drawing-frames for drawing fiber in the several processes in textile-mills, the object being to provide means in lieu of the usual weights, springs, or levers for holding down rolls and also to furnish means for automatically releasing pressure should the sliver lap around the drawing-rolls or other obstruction occur in the fiber.

NUT-LOCK.—H. A. HOUSE, Aspen, Col. The improvement made by this inventor consists of certain novel features of construction which provide a simple, cheap, and efficient locking device for nuts, which will effectually prevent retrograde movement thereof and which will permit the nut to be readily applied or removed.

APPARATUS FOR HEATING FLUIDS OR FLUID MIXTURES.—F. S. CHAPMAN, Kenton, Ohio. This apparatus comprehends a pair of electrodes incased in a non-electric conducting-body, with their opposing faces separated to form a passage-way for the fluid, and a metallic casing which serves as a solid exterior for holding the electrodes and their surrounding non-electric body intact during the handling of the complete device, and which also serves as a convenient means for joining with the faucet of ordinary house-service pipes.

MANUFACTURE OF TABLE KNIVES, FORKS, OR SIMILAR ARTICLES.—H. JOEST, Hanover, Germany. The intention in this case is to connect a tang throughout its length, or nearly so, with a handle and at the same time anchor it in the handle, so as to protect both tang and handle against the entrance of liquid and render them immune to the effects of acid liquids or vapors. This is attained by casting around the tang of a knife or fork in a mold an alloy of aluminium and magnesium. This adheres closely to iron or steel, behaving toward the latter like a solder, so that the tang becomes a part of the handle.

INK-REDUCER AND PROCESS OF MAKING SAME.—F. FISHER, Brooklyn, N. Y. By means of this reducer printers' ink is softened and caused to properly adhere to paper, thus preventing the liquid from peeling off. The reducer also prevents the ink from being offset from the paper, that is, it prevents the application of excessive quantities. Owing to this, and to the ink treated with the reducer, drying very rapidly, fresh-printed sheets placed one upon the other will not adhere nor will a lower sheet transmit its impression to the back of an upper sheet.

TOY.—O. F. HALE, Pocahontas, Iowa. The invention in this case resides in a novel manner of sustaining a clown in an upright position, and in the peculiar arrangement of those parts in connection with a spring-board on which the clown stands and which is vibrated to produce the desired movements of the clown or other performer.

HOSE-COUPLING.—E. J. PACE, Salem, Ohio. The object of this invention is to provide a coupling for water, steam, or air conducting hose which has novel duplicate connecting sections, is very simple, easy to connect and detach, is reliable in service, and is light, durable, and of shapely design, and has no projections from its general surface.

COMBINED CANE AND CHAIR.—R. C. DULIN, McKeesport, Pa. This combined cane and chair consists of a simple, strong, and cheap article in which the parts fold compactly in order to facilitate transportation or handling, the seat being easily unfoldable for use to afford support for the person. The construction admits of the use of two seats in connection with a single staff. The article is equipped with means for the attachment of an umbrella.

TOY BOAT.—A. M. ROYSE, Winchendon, Mass. In this toy the purpose is to so construct the metal hull of a keel boat that when the boat is not in water or when it is packed, the keel can be folded, thus facilitating packing and carriage, and to reach such a result in a simple, practical manner, and so that when the keel parts are in position for use, the keel will be as rigid as if made of one piece.

REVERSIBLE SMOKE-STACK.—S. T. WALTON, New York, N. Y. The smoke-stack is so constructed, that it may be turned end for end, whereby to readily clean the stack, the stack remaining upon its pivots, and to provide means for securing the stack to its base, whichever end is uppermost, by means of a slip collar and guys. It is made to be readily reversible and conveniently secured in proper position.

MEANS FOR REPAIRING BOOTS AND SHOES.—G. W. CASE and D. L. SWINTON, JR., Port Jervis, N. Y. The intention of the inventors is to provide an apparatus by which a new rubber sole may be expeditiously applied to the upper of a boot or shoe or a rubber patch may be vulcanized on a worn boot or shoe at the heel or sole thereof, the new sole applied by their apparatus having a surface, whereby repairs may be effected and the owner saved the expense of buying new articles. The inventors also provide a mold having a pattern-surface to give the corrugated face to the bottom of the new rubber sole.

BUILDING BLOCKS.—W. D. KILBOURN, Pueblo, Col. The object of this invention is to provide a series of blocks of various shapes by means of which a great variety of structural devices in miniature may be built up, thus not merely providing amusement as a toy, but serving to develop the mechanical ideas of a child or person.

CLUTCH.—M. MCHALE, Phœnix, and J. TRAINNER, Eholt, Canada. The invention in the present case has reference to new improvements in clutches, the object in view of the inventors being to provide a clutch of simple construction and adapted for use for various purposes—such, for instance, as a drill-chuck or for locking together two members of a tripod-leg.

GLOVE.—A. G. HOEGREN, Chicago, Ill. This glove invention has for an object, among others, to provide an improvement in the cut of the inside portion of the palm and fingers of the glove whereby to secure a considerable width in the inner sections of the finger pieces of the glove.

HARNESS-LOOP.—J. H. R. HAUCK and J. L. WARDEN, Pleasanthill, Mo. In this case the invention relates to harness-loops formed of metal; and it consists of a peculiar loop of that character involving novel and improved securing means. The loop is adapted to be applied to any strap or portion of harness with less liability of severing the stitches than with any similar loop known to the inventors.

APPARATUS FOR CONTINUOUS FRACTIONAL DISTILLATION OF PETROLEUM.—W. D. PERKINS, Oil City, Pa. Mr. Perkins, in this case, provides an apparatus by which the fractional distillation of petroleum or similar liquids is effected continuously and rapidly, so that several distinct products are obtained, the same differing in specific gravity and other qualities. The whole operation is practically effected automatically, it being only necessary to supply gas, water, and steam in a certain manner.

SUSPENDER-BELT.—L. REITER, New York, N. Y. This contrivance is an improvement in those devices which serve as combined suspenders and belts, the devices being readily convertible from one of the articles to the other. The construction provides for neatness and effectiveness; this is particularly so in the case of the belt, since when adjusted as a belt the article does not appear to be anything more than such.

HAIR-CRIMPER.—MARGUERITE I. CONNELL, New York, N. Y. The purpose in this case is to provide a curler having a pliable body made of soft rubber—for example, in spiral form—and an elastic retaining device in the form of a tie or an equivalent device capable of extending practically from one end of the body to the other for the purpose of retaining the hair in position upon the body of the curler, the hair being wound on the body to impart a wave to the hair when the device is removed. This device for curling or waving the hair is used without heating and will not cause discomfort during repose.

FEEDER FOR FOUNTAIN PENS.—J. WEEKS, Brooklyn, N. Y. Provided in this invention is a reliable feeder for pens adapted to any barrel and so constructed that it may be used in connection with any style of pen, the pen constituting a valve for the outlet of the feeder, normally concealing the outlet, but automatically opening it to supply ink the moment the pen is brought into action and enabling the pen to be carried point down without danger of leakage, and kept constantly moist with ink, in condition for instant use.

THIMBLE PUZZLE.—H. SCHIERHORST, New York, N. Y. In the operation of this puzzle a person removes a cover and holding the device by means of the base tilts the box from side to side, so as to roll the thimbles around in any manner. The purpose is to lodge the thimbles upon bosses; but the operator may vary the game by trying to lodge one of the thimbles upon a particular boss, or to lodge both upon the bosses.

FOLDABLE PAPER BOX.—H. LOWY, New York, N. Y. The inventor's object in view in this improvement is to rapidly and economically produce a box-blank which is of such form that it can be bent or folded easily to complete the box and have its parts so arranged and interlocked that the use of paste or other mucilaginous material is obviated. The box-blank can be stamped or cut without waste of the paper-stock, and the box resulting from the bending of the blank is held together by the engagement and interlocking of its parts.

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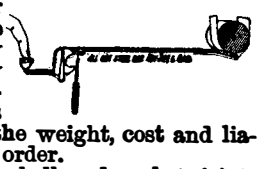

which takes the place of twenty pieces ordinarily used and saves fully 1,200 parts. This greatly decreases the weight, cost and liability to get out of order.

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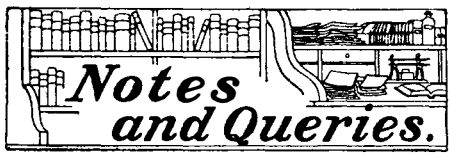

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(9067) C. N. writes: It has been asserted recently in a photo-magazine that the beam of light entering the lens of a camera during the exposure of a plate for 1-1000 of a second is 185 miles long. (1-1000 part of the velocity of light taken at 185,000 miles per second.) It is stated in support of the allegation that the light entering the lens during an exposure has "its origin in the sun, and the beam, or rather the multiplicity of rays, hit the object, are reflected therefrom, and ultimately reach the plate. Without contesting the explanation of the action of light, is the explanation a sound argument that the length of the beam is 185 miles? If not, is the length merely the distance of the object—say 50 feet from the camera? A. The statement as quoted from the journal is quite correct. As much light strikes the plates as light travels in the time of exposure. A second exposure, and 185,000 miles of light waves strike the plate. The light does not stand still between a plate and an object 50 feet away. It comes from the object all the time. It moves as fast from the object to the camera as it does anywhere in the air. And the action of the light is cumulative upon the plate; 185 miles of waves beat against the plate and affect it 1-1000 as much as 185,000 miles of waves would do.

(9068) H. L. F. says: Can a locomotive make better time on a high mountain than on the sea level, provided that the grade is the same in each case? It appears as though if air is rarer there would be less back pressure, and for that reason the steam would act more powerfully on the piston rod. A. Whatever advantage in steam pressure a locomotive would derive at a high altitude from the reduced pressure of the air would be met by the reduction of the quantity of oxygen in the air. If back pressure is reduced by the former cause, the amount of air needed to consume a certain weight of coal would be increased by the latter. We also think that the steaming qualities would be impaired on the mountain. We have not data of actual runs at hand, but should not expect any great difference between sea level and the altitudes attained by ordinary roads.

(9069) J. D. asks: 1. Can a small glass coherer for wireless telegraphy be made to work without the air being exhausted? What is the cost of making one? A. A coherer will work without exhausting the air, but will not be durable owing to the oxidizing of the grains of the metal in the air. The cost of the coherer unexhausted is not large; we cannot say just what it may be. 2. Can I use a small hand dynamo instead of an induction coil to get a spark in front of the coherer? A. A hand dynamo will not give a spark of the sort which an induction coil will give. To send even for a short distance, under a mile, will be best done with a coil giving at least an inch spark. 3. I passed a current from ten O. K. dry cells over the coherer tube, but could not get the bell to ring (a small door bell) except I brought both wires together. The tube was a small glass tube 1½ inches long, two copper wires and some nickel and silver filings. A. Ten or a hundred dry cells will not give any current across a piece of glass. 4. What size spark and what would be the cost of a coil which would enable me to send a message a mile? Please give the amount of wire to make an induction coil which would give a 2-inch spark, and any other useful hints regarding its construction will be anxiously looked for. A. For a 2-inch spark the dimensions should be as follows: Core, 9 inches long and 1 inch in diameter, No. 22 soft iron wire; primary coil, No. 14 magnet wire, two layers on the core; secondary, No. 36 silk-covered magnet wire, 2½ pounds; condenser, 60 sheets of tinfoil, 6 x 6 inches. The paper sheet, 7 x 8½ inches. For the construction of such a coil a book like Norrie's "Induction Coils" is almost indispensable.

(9070) A. N. asks: 1. How can I make a wireless telegraph? A. The set of wireless telegraph apparatus which is best adapted to be made by an amateur is described in the Scientific American, September 14, 1901. 2. I have 2½ pounds of No. 31 B. W. G. double-cotton-covered copper wire. Now I want to know how to use this wire to the best advantage in making an induction coil, not making it (the coil) any longer than possible. How much wire must I use in the primary coil, and size? Is paraffine wax as good to insulate the layers as shellac? Can oiled paper be used on a small coil of about ¼ inch? In making a coil, is it best to have the coil long and thin or short and thick? A. A wire as large as No. 31 is not to be advised for making an induction coil. It will, however, give some spark, but not as long as No. 36 wire would give. The data for a coil are fully given with mode of construction and figures and dimensions of all parts in Norrie's "Induction Coils," which we can send for $1 by mail. If you buy the book, you will find all the questions you have asked explained, and more which you will soon be desirous of asking as you go on with the work. 3. Is there any easy way by which B. W. G. may be changed to B. & S. wire gage, or B. & S. to B. W. G.? A. There is no relation between the B. W. G. and the B. & S. sizes of wire. The way to compare sizes is to have a copy of both tables and see the diameters of the sizes in each.

(9071) D. A. A. asks: What horse power could be developed with latest improved turbine, with stream of water filling 12-inch pipe with fall of 10 feet? A. A stream filling a 12-inch pipe does not signify the quantity of water flowing in any given time, which is essential in estimating horse power. You will find in Scientific American Supplement, Nos. 788, 789, 791, 805, 1049, a very complete series of articles on the measurement of water power and its development by water wheels and motors; 10 cents each mailed.

(9072) J. C. McC. asks: 1. Would like to know how I can estimate the lifting power of an electro-magnet. A. The usual formula for magnetic traction as given in Thompson's "Electromagnet" is that a magnet will lift 147 pounds per square inch of polar surface when there are 100,000 lines of magnetic flux per square inch of cross section of core of magnet. It will be easier for you to put the current upon the magnet and find how much it will lift. Or if you wish to work the matter out by theory, get Thompson's "Electromagnet," price $6, or Fleming's "Magnets and Electric Currents," price $3.50, and study it up. 2. Can the porous cups and carbons of Leclanche batteries be renewed? If so, how? A. The carbons of a battery never are exhausted. As long as they last, they are as good as ever. The material in the porous cup, the dioxide of manganese, becomes exhausted of oxygen, and is thus worn out. The porous cup is often filled with iron rust in its pores, and is usually thrown away when exhausted.

(9073) M. F. S. says: Will you please give, in an early number of the Scientific American, a receipt for polishing horns for hat racks, etc.? A. First scrape with glass to take off any roughness, then grind some pumice stone to powder, and with a piece of cloth wetted and dipped in the powder, rub them until a smooth face is obtained. Next polish with rottenstone and linseed oil, and finish with dry flour and a piece of clean linen rag. The more rubbing with the stone and oil, the better the polish. Trent sand is used in the Sheffield factories. It is a very fine and sharp sand, and is prepared for use by calcining and sifting.

(9074) J. F. R. says: Have you any articles in Scientific American Supplement showing the construction of a spark coil giving a spark of 2 inches or upward? Also an article showing an adjustable vibrator for same? A. Our Supplement No. 160, price 10 cents, gives full plans for a coil giving with ease a spark 1½ inches long. By winding a half pound more of wire on the secondary you should obtain a spark 2 inches long from the coil. A better proportioned coil with winding in sections for sparks may be found described in Norrie's "Induction Coils." These descriptions tell how to make vibrators as well as all the other parts of the coil.

(9075) J. W. H. says: Will you kindly tell me how to rid a house of cockroaches? A. Some years ago we had a cockroach powder analyzed and found it to consist of powdered borax 90 per cent; corn starch 10 per cent, and a little coloring matter. We think this will answer your purpose.

(9076) G. B. asks: 1. I have read that the earth has eleven motions. Please explain them. A. We have never seen the statement that the earth has eleven motions, and cannot explain them. It has more than eleven motions. It rotates upon its axis, causing day and night. It moves around the sun, causing the year. It goes with the sun in space. Of this and all other motions of the earth we are not conscious. It is moved by the attraction of the moon to and fro each month, some thousand miles or more. It is moved to a less degree by each of the other large planets, seven in number. This would make eleven motions, but there are others. It has recently been found that the earth shifts a little, so that the north pole of the earth seems to describe a path in the earth. The axis is not always in the same place. In addition we have the familiar motions of nutation, due to the change of position of the moon with reference to the ring of matter around the earth's equator, and precession of the equinoxes due to the similar positions of the sun. All these may be found given in any textbook of astronomy. Todd's "New Astronomy" is a reliable work upon the subject. 2. What were the two prize problems that were solved in 1687 and 1716 by Sir Isaac Newton? A. We cannot find that Newton solved any prize problems in the years stated. His *Principia* was published in 1687, and he became the most famous man of his time. In 1693 he published the method of fluxions. Perhaps it is to this that reference is made. In 1713 the final publication of the *Principia* as we have it occurred. Newton was then 71 years old. We doubt if he competed for any prizes after that date. 3. Give a formula for the pull toward the plane of rotation of a centrifugal engine governor, the single-arm type. A. The pull of centrifugal governor balls toward the plane of rotation is equal to their centrifugal force due to velocity, minus the weight of the balls, multiplied by the sine of the angle of the arms to the plane of rotation, if horizontal. 4. How can aluminium be powdered? A. Aluminium can be powdered by mechanical means, as emery, etc., are powdered. The various grades may then be separated by the water process. We do not know any way of precipitating aluminium chemically in a finely-divided state.

(9077) A. S. asks: I have some dry batteries that have partly run out, and I would like to know what I can put in them to strengthen them. A. Dry cells are usually thrown away when exhausted. You can punch a hole in the top and fill them with a solution of sal-ammoniac and water, and use them as wet cells till the zinc is used up. Some have charged them like storage cells and given them further life. The cost of this is probably more than the service obtained from the recharged cells. It is probably quite as cheap to buy new cells.

(9078) H. W. H. asks: Is there more expansion of a charge of air and gas when burnt or exploded in a closed chamber than in a jet in the open? What is the cause of a pipe snapping when steam is first turned in it? A. The result of the burning of a certain charge of gas and air is not dependent upon its being in a closed or open space. The same amount of heat and gases should be produced, whether the explosion takes place in the open or in a closed chamber. In the open air the resulting power cannot be used, and is soon dissipated into the space around. The noise produced when steam is turned into a cold pipe is due to the partial vacuum produced by the condensation of the steam. It is called a water hammer.

(9079) P. E. J. asks. When the elements cæsium and rubidium are placed in water they decompose it with the liberation of H, which takes fire, but does Cs give the flame a blue color, or Rb a red? In nearly all books on chemistry I find that the element erbium has never been isolated. On looking through Merck's Index, 1896, a catalogue of nearly every chemical known, I find it thus: "Erbium (E) metal, dark gray powder." Also tell me if this element is not like didymium, which has been split into different elements? A. Cæsium was named from the blue lines which its flame gives in the spectrum, of which there are two. The word cæsium means skyblue. Rubidium in a similar way gives two dark red lines. The word rubidium means dark red. Both are from the Latin.—With reference to erbium, Remsen's "College Chemistry" says: "A final statement cannot be made as yet. It is even questionable whether it is an element."

(9080) J. D. says: Will you kindly tell me how and what preparation is used in sticking pictures on glass so that it will not blister? Most of the art stores have for sale pictures that they call "medallions," which appear to be a piece of glass pasted over the front of a picture. I have endeavored to do this, and have wet my picture and coated the glass with a thin coating of thin white glue and also paste, and also with library paste. It looks very well while it is moist, especially after I have rubbed all the air bubbles out, but after it dries it appears flaky in places, as if the picture did not stick to the glass. I have also tried putting the picture on under water, thinking by this means to keep the air from getting between the picture and the glass. A. According to the Werkstatt, clean the inner hollow side of the glass thoroughly, pour on gelatine dissolved in boiling water, lay the picture on and pour on gelatine again, so that everything swims. Then neatly remove what is superfluous, so that no blisters result, and allow to dry. The following recipe is said to be still better: Gelatine, 16 parts (weight); glycerine, 1 part (weight); water, 32 parts (weight); methylic alcohol, 12 parts (weight). The mixture is prepared by causing the gelatine to swell in water, then dissolving it with the use of moderate heat, adding the glycerine, stirring thoroughly, and pouring the whole in a thin stream into the alcohol.

(9081) The I. L. & S. Co. ask: Can you furnish us the formula for a dry powder chemical fire extinguisher, such as is used to throw on fire to extinguish? A. 1. Alum 24 per cent, ammonium sulphate 52 per cent, ferrous sulphate 4 per cent. 2. Common salt 60 per cent, sal-ammoniac 60 per cent, sodium bicarbonate 80 per cent. 3. Sal-ammoniac 100 per cent, sodium sulphate 60 per cent, sodium bicarbonate 40 per cent.

(9082) A. G. S. asks: 1. Is there any way to make an electric automobile run by a 5 horse power motor, so that you could charge the batteries while making a run if you used two sets of batteries, or if you had three sets and have two sets charged all the time, while you charge the third, then throw one of the first set out, and throw the third set in the circuit to take the place of the one you threw out of circuit? A. The plan to charge a part of a storage battery of an automobile while the carriage is in use is not feasible. It would require a dynamo on the carriage and a battery capable of running a motor large enough to run the carriage and the dynamo at the same time. The dynamo must furnish current enough to charge nearly one-third of the battery while another third is running the carriage, and the last third is running the dynamo. That is, two-thirds of the battery is to run the motor, and one-third to be charged. If perpetual motion were possible this would be possible. But so long as there is always a loss of power by friction and other resistances the scheme will not work. 2. Is there any power lost in running machinery with belts, and if so what per cent? A. There is a loss by friction, which varies according to the conditions such as the size of pulley, etc. 3. Is there any power lost in the transmission of a current of electricity, and if so what per cent? A. Power is always lost in transmitting electricity. That is, power is required to drive an electric current through a wire. The loss depends upon the length of the wire. A dynamo of moderate size may lose as much as ten per cent. A large one will lose less. The line loss in a long line may be as much as thirty per cent. A motor will lose from five to ten per cent. 4. Can you boil machine oil or linseed oil without having an explosion? A. Oil may be heated without taking fire. Care is always necessary when heating any inflammable substance. 5. Have you a machine shop where you make experiments? A. We have adequate laboratory facilities at an institution of learning in this city.

(9083) C. S. N. asks: As the cause of my electric gas lighter failing to work, I found the connection between the wire from battery and pipe had become loosened. After removing the old wire and making a new connection, I found that the old wire had become silvered in appearance, as if it had been immersed in silver-plating solution. The wire was an ordinary copper bell wire from which I had removed the covering. I have four Gonda cells and 8-inch spark coil. The coil was on + wire between the battery and pipe connection. I afterward changed the spark coil to the — wire; leaving the + wire connected to gas pipe as before. Can you give me an explanation of the silvered appearance of the wire, and could the fact of my long-distance telephone being grounded by means of the gas pipe have anything to do with it? Which wire should be connected with the gas pipe, or does it make no difference? A. We have tested the coating upon the wire, chemically, as well as can be done with so small a quantity. It appears to be zinc. If the pipe to which the wire was attached was galvanized, this would indicate electrolysis, provided the wire was from the positive or carbon pole of the battery. The coating of the wire might be solder if any solder were in contact with the wire. It makes no difference which wire is attached to the gas pipe so far as the service of the bell is concerned. If there is a loose joint and electrolysis takes place, the wire is eaten off, which is attached to the zinc of the battery.

(9084) B. B. H. says. 1. I understand that electricity does not flow through the wire, but around it. Explain in what way wire acts as a conductor to electricity? A. An electric current of ordinary pressure, or voltage, flows through the metal of the conductor. It always excites a magnetic field around the wire, but the wire is in reality the conductor of the current. A discharge of very high potential, such as lightning, passes along the surface of a wire without penetrating the metal very deeply. It is this that your remark refers to, and not to an ordinary current of moderate voltage, as, for instance, any voltage up to 1,000 to 5,000, or any voltage used by man for power or light. All these flow through the metal of the conduc-

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tor. 2. In what is the Edison socket considered a better s et than the T. H. socket? A. We cannot say at we think one of these sockets is better than the other. Both have their friends. One uses a screw, the other holds the lamp by springs. 3. How is it that lightning goes from earth to cloud, as well as from cloud to earth? Electricity does not flow from negative to positive, and the earth being considered as negative, how does the lightning go from earth to cloud? A. We have many times stated in these columns that the direction of the flow of electricity is entirely conventional. We agree to the ordinary flow from what we call positive to what we call negative. An alternating current is considered to flow both ways alternately. The fact is that lightning frequently surges to and fro between the cloud and the earth a dozen times or more in what we call a flash, and it is all over in a very small fraction of a second, so that no one can say that he saw it go either way. It is as easy to see the flash go up as it is to see it come down. 4. A short time ago I was in a telegraph office, and there was a thunder storm going on around us; every lightning stroke would cause the telegraph instrument to tick, as if the key has been opened and closed. Why should the lightning affect the instrument in such a way? A. Induction charges a telegraph line when a lightning storm is near, and the current sparks across the instruments and the lightning arresters with the snapping sound which you heard. It is a common occurrence. 5. What kind of a conductor of electricity does liquid air make? A. Liquid air is an insulator, just as gaseous air is. It is not a conductor of electricity at all.

(9085) G. A. S. asks: In order to settle a controversy, will you kindly give a solution of the following problem in the next issue of your paper: A claims that if a gun be fired from the rear of a rapidly moving train, at a given point, in the opposite direction, and the velocity of the bullet is exactly the same as that of the train, when the train has traveled one mile distant from the point of discharge, the bullet will be one mile from the train, or at the point of discharge. B claims that the bullet will be beyond the point of discharge, when the train has traveled the distance of one mile. Who is correct? A. For a full answer to your inquiry regarding a gun discharged from a train in the direction opposite to the motion of the train, see the SCIENTIFIC AMERICAN, Vol. 88, No. 19, Query 8997. A is right.

(9086) A. M. W. says: In your paper of June 6, Notes and Queries, 9036, in regard to clear glass assuming a violet color: A number of years ago I resided in various mining towns of Colorado, and often found pieces of glass of an amethyst color. On one occasion I found a broken table goblet, but the portion that lay upon the ground was not as perfectly colored as other parts. I do not remember ever finding any of this colored glass only on very dry, rocky slopes and where it was exposed to direct hot sun rays. Occasionally I would find a piece that was blotched as though rain drops had dried so quickly that the outer edges of the spots had a seared appearance, but it was color only and a little darker on these edges. At that time my impression was that it was necessary for the glass to be in a very dry, rocky place, fully exposed to the sun, and after little showers and spattering drops from surrounding rocks, in drying quickly from the hot sun that it caused some chemical action that formed the coloring.

(9087) J. H. writes: Will you please inform me who manufactures the gas ignition pellet for sale? Also what the ingredients are, and in what proportion they are mixed, and how fastened to the mantles which render them self-igniting mantles? A. There is only one substance within our knowledge which can be heated by a stream of gas striking it, so that it will ignite the gas. That substance is spongy platinum. It is used in the Döbereiner lamp, where a stream of hydrogen impinges on a platinum sponge. Platinum in this form is capable of absorbing 800 times its volume of oxygen, which does not enter into combination with it, but is simply condensed into its pores, and is available for combination with other bodies.

(9088) C. M. Z. asks: Please tell me what is the voltage of a good dry cell 1½ x 4 inches. Will a battery of this size light a small lamp of 2 c. p. and 4½ or 5½ volts? Is one battery 8 inches long and 1½ inches diameter as good as two batteries 1½ x 4 inches long? A. The voltage of a dry cell is about 1.5 volt. To light a lamp of 5½ volts will require four cells in series. The size of a cell does not affect the voltage. This is determined by the materials employed. The size of a cell determines the current it will give and the time it will last.

NEW BOOKS, ETC.

THE LOCOMOTIVE. New Series. Vol. 23. Hartford, Conn. 1902. 8vo. Pp. 191. Price $1.

Through the courtesy of J. M. Allen, A.M., M.E., the editor of the Locomotive, we received the last volume. This interesting publication is issued by the Hartford Steam Boiler Inspection and Insurance Company, and deals with matters germane to steam boilers, power, etc., but occasionally there are published excellent scientific articles on various subjects. The periodical is well illustrated by half-tone and line drawings. Among the features of the Locomotive is a list of boiler explosions with details.

ELEMENTS OF STEAM ENGINEERING. By H. W. Spangler, Arthur M. Greene, Jr., and S. M. Marshall, B. S. in E. E. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1903. 8vo. Pp. v, 275; 273 figures. Price $3.

This book is intended to bring before the beginner examples of the various forms of steam apparatus used in modern steam power plants; to explain simply and briefly the construction, use and reasons for using these various parts of machines, and to give a working vocabulary in this branch of engineering. Although the book is primarily prepared for first year students in engineering schools, it will probably be of use to the general reader and to many of the young men in manual training schools and institutes.

HEREDITY AND SOCIAL PROGRESS. By Simon N. Patten. New York: The Macmillan Company. London: Macmillan & Co., Ltd. 1903. 12mo. Pp. vii, 214. Price $1.35.

Prof. Patten has presented here what may well be considered a thorough and clear discussion of a subject which, thanks to Herbert Spencer, has become of constantly increasing importance within recent years.

PROBLEMS IN ASTROPHYSICS. By Agnes M. Clerke. Containing 81 illustrations. London: Adam & Charles Black. 1903. Pp. xvi., 567. Price $6.

The present work deserves more than usual attention by reason of the scholarly standing of its author as a writer on astronomical subjects. The book which lies before us is characterized by the same excellence which it was our privilege to note in the author's recently published "History of Astronomy During the Nineteenth Century." It is the purpose of the present work not so much to instruct as to suggest. The volume represents a kind of reconnaissance, and embodies the information collected by astrophysical scouts and skirmishers regarding the practical lines of advance and accessible points of attack. The book is divided into two parts, the first of which discusses solar physics, and the second, problems in sidereal physics.

LEAD AND ITS COMPOUNDS. By Thomas Lambert. Illustrated by 40 plans and diagrams. London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1902. Pp. xiv, 228. 8vo. Price $3.50.

The author shows in this volume the great strides which have been made in the metallurgy of lead and zinc. He has incorporated the latest applications of electrical science, not only in cleaning the ores, but also in their after-treatment. The work contains a description of the pigments of both metals, their mixture and properties. The value of the book is enhanced by a chapter devoted to the assaying and analysis of lead and zinc ores, and the quantitative test of paints and oils.

SIDEROLOGY. THE SCIENCE OF IRON. By Hanns Freiherr v. Jüptner. Translated from the German by Charles Salter. The Constitution of Iron Alloys and Slags. With 11 plates and 10 illustrations. London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1902. 8vo. Pp. viii, 344. Price $5.

This book may be regarded as a compilation of our present knowledge of iron as it is to be found in the widely-scattered literature on the subject. The work furthermore gives to the student an account of the researches which have been already carried out and explains to the consumer of iron and steel the connection between the various properties of iron and steel, their constituents, and the methods of working the raw material. The work is divided into three portions, the first of which, after describing the theory of solution deals with the microscopical and chemical constituents of iron and slags. The second part treats of the connection between the chemical composition, the working, the microscopical structure, and properties of iron and steel. The third part deals with the reaction between the metal, slags, and other reagents.

THE ART OF ENGRAVING. A Practical Treatise on the Engraver's Art. With Special Reference to Letter and Monogram Engraving. Specially Compiled as a Text-Book for Students and Reference Book and Guide for Engravers. With 200 original illustrations. Philadelphia, Pa.: Keystone Publishing Co. 1903. 8vo. Pp. 199. Price $1.50.

This seems to be a thoroughly practical book of utility to the skilled engraver as well as to the learner.

THE NEW INTERNATIONAL ENCYCLOPÆDIA. Editors Daniel Coit Gilman, LL.D., Harry Thurston Peck, Ph.D., L. H. D., and Frank Moore Colby, M. A. Volume VII. New York: Dodd, Mead & Co. 1903. 8vo. Pp. 888.

This new volume of the International Encyclopædia takes us from "Ethics" to "Fuller-Maitland." Following the plan which we adopted in reviewing the volumes previously issued, we have confined our attention only to the scientific portions. The article "Evolution" is a most excellent review of the development of Herbert Spencer's theory from the modern, scientific standpoint. A good bibliography is appended to the article. The discussion of "Explosives" may well be considered the best to be found in any of the cyclopedias. Treating as it does of the latest brown and smokeless powder, the article may be considered perhaps the most modern on the subject to be found in any reference book. The article on "Fire Engines" presents all that is worth knowing of modern American fire engines. It is well illustrated by excellent pictures of a chemical fire engine, a hand chemical fire engine, and an American model of 1902. We are glad to note that the subject of modern steel-frame buildings is adequately treated in the article on "Fireproof Construction." For the purpose of illustration, the "Flatiron" building in course of construction has been selected; a better selection could hardly have been made, for the picture illustrates the modern method of constructing the interior steel work first, and then of applying the outer masonry in sections. The scientific biographies are well written. That on Faraday, although brief, is quite adequate. The biography of Benjamin Franklin should have discussed more fully Franklin's scientific achievements. Of the scientific articles in this volume, perhaps the most technical and the most thorough in treatment is the one on "Freezing Point." The discussion of fuel is also good.

TASCHENBUCH DER KRIEGSFLOTTEN. IV. Jahrgang. 1903. Mit teilweiser Benutzung amtlichen Materials. Herausgegeben von B. Weyer, Kapitänleutnant a. D. Mit 277 Schiffsbildern und Skizzen. München: Verlag von J. F. Lehman. 1903. 16mo. Pp. 321. Price $1.

Capt. Weyer's book comes to us this year in a form that is even better than that of the work which he published last year. The information which he gives is fully as trustworthy as that which is contained in some of the more pretentious naval annuals. His tables, so far as we have been able to discover, seem accurate and comprehensive. The publishers are to be congratulated on the manner in which they have issued this work. The printing and the character of the illustrations are much better than those of the previous volumes.

THE STORY OF THE TRAPPER. By A. C. Laut. Illustrated by Arthur Heming and others. New York: D. Appleton & Co. 1902. Pp. xi, 284. Price $1.25.

In the "Story of the Trapper" is presented a vivid picture of an adventurous figure painted with a singleness of purpose and a distinctness impossible of realization in the large and detailed histories of the American fur trade and the Hudson's Bay and Northwest Companies, or the various special journals and narratives. The author's wilderness lore and knowledge of the life, added to an acquaintance with its literature, has borne fruit in the personification of the western and northern trappers who live in these pages.

THE GREAT SIBERIAN RAILWAY FROM ST. PETERSBURG TO PEKIN. By Michael Myers Shoemaker. New York and London: G. P. Putnam's Sons. 1903 12mo. Pp. viii, 243. Price $2.

In these pages will be found a record of a journey over the Siberian Railway from St. Petersburg to Pekin, with a detour to Corea. The author bases his statistical information on the work published by the Minister of Ways and Means of Communication, "A Guide to the Great Siberian Railway."

THE ANALYSIS OF OILS AND ALLIED SUBSTANCES. By A. C. Wright. New York: D. Van Nostrand Company. London: Crosby, Lockwood & Son. 1903. 8vo. Pp. xi, 241. Price $3.50.

The author tells us that this brief account of the methods used in the analysis of oils, fats, and waxes has been written with the definite aim of presenting the subject in a form suited to the needs of the student and beginner, and that it includes all recent developments likely to be found of value in practical work. In accordance with this purpose, the chemistry of the various processes is explained in some detail, and methods which have been recently proposed are fully explained. An estimate has been made to indicate the extent to which reliance may be placed upon methods for detecting adulteration. Stock comparisons for estimating each constant have also been selected.

PHYSICO-CHEMICAL TABLES FOR THE USE OF ANALYSTS, PHYSICISTS, CHEMICAL MANUFACTURERS, AND SCIENTIFIC CHEMISTS. In two volumes, each complete in itself. By John Castell-Evans, F.I.C., F.C.S. Vol. I. Chemical Engineering and Physical Chemistry. London: Charles Griffin & Co., Ltd. Philadelphia: J. B. Lippincott Company. 1902. 8vo. Pp. xxxii, 548.

Mr. Castell-Evans has reason to be proud of his work. He has been a most painstaking compiler, so painstaking, indeed, that his work must at times have seemed little short of scientific drudgery. His task must have involved years of labor. The work has been designed to be of use to all engaged in any branch of chemistry and metallurgy. The volumes will be the means of saving a great deal of time that can be more profitably and pleasantly employed in true scientific work.

ANALYSES OF PIG IRON. Vol. II. Collected and published by Seymour R. Church. San Francisco. Pp. 197. Price $5.

The contents of this volume are in no sense a repetition of Vol. I, but are made up entirely of new and additional analyses, data and leading articles. The analyses published in this volume, as well as in the first, are taken directly from reports furnished by the respective furnaces or their agents. These reports are to be kept on file for the inspection and convenience of subscribers. The book presents authoritative analyses which should be of great service to the ironmonger. The publisher is to be congratulated upon the very handsome manner in which he has issued this book. Its full leather binding, heavy coated paper, fine printing and admirable illustrations are not often found in technical works.

STEAM POWER PLANTS: THEIR DESIGN AND CONSTRUCTION. By Henry C. Meyer, Jr., M.E. New York: McGraw Publishing Co. 1903. Pp. 159.

Mr. Meyer has presented us with a very carefully prepared work on a subject with which many engineers are familiar, but of which they by no means know all that they ought to know. The most noteworthy features of the book are sixteen folding plates of ground plans, sectional elevations, and the like. These will be of especial service to the power engineer.

CONDUCTORS FOR ELECTRICAL DISTRIBUTION, THEIR MATERIALS AND MANUFACTURE, THE CALCULATION OF CIRCUITS, POLE-LINE CONSTRUCTION, UNDERGROUND WORKING AND OTHER USES. By F. A. C. Perrine, A.M., D.Sc. New York: D. Van Nostrand Company. London: Crosby, Lockwood & Son. 1903. 8vo. Pp. vii, 287. Price $3.50.

Dr. Perrine's experience as a manufacturer of insulated wires and cables, as a consulting engineer on their installation, and as a teacher of electrical engineering at Leland Stanford, Jr., University, renders him peculiarly well fitted to prepare a book on electrical conductors. The fourteen chapters of which this work is comprised discuss inductive materials, alloyed conductors, the manufacture of wire, wire finishing, wire insulation, cables and their use, classification of cables, calculation of circuits, Kelvin's law of economy in conductors, multiple arc distribution, alternating current calculation, overhead lines, pole line, line insulators, and underground conductors.

WALLPAPERS AND WALL COVERINGS. A Practical Handbook for Decorators, Paperhangers, Architects, Builders, and House-owners. With many Half-Tone and other Illustrations Showing the Latest Designs. By Arthur Seymour Jennings. New York: William T. Comstock. 1903. 8vo. Pp. 161. Price $2.

The present work may be regarded as an enlarged republication of "Practical Paper Hanging," brought out by the author several years ago. The volume covers the field more fully than the previous work and is furthermore more elaborately illustrated with half-tones of the latest designs of a large number of manufacturers in America, England, and France. Among the chapters which deserve special mention are those on the "Selection of Wall Papers," and "Different Varieties of Wall Papers and their Characteristics." Rules are given showing how difficult or unusual obstacles should be met.

RAILROAD CONSTRUCTION. THEORY AND PRACTICE. A Text-Book for the use of Students in Colleges and Technical Schools. By Walter Loring Webb, C. E. New York: John Wiley & Sons. London: Chapman & Hall, Ltd. 1903. 16mo. Pp. xvii, 675. 232 figures. Price $5.

Since the issue of the first edition the author has conferred with many noted educators in civil engineering. As a result, it was decided to recast the whole work and to reduce the size of the book from octavo to pocketbook dimensions. The original text has been almost doubled by the addition of several chapters on structures, train resistance, rolling stock, etc., and also several chapters giving the fundamental principles of the economies of railroad location. The author's primary aim has been to produce a textbook for students.

DESCRIPTIVE GEOMETRY. With Numerous Problems and Practical Applications. By William S. Hall, C.E., E.M., M.S. With a 4to Atlas of 18 Plates. New York: D. Van Nostrand Company. 8vo. Pp. iv, 76.

Textbooks of descriptive geometry, with very few exceptions, deal only with first angle projection, but in the best recent practice in mechanical drawing the third angle is used. Moreover, the third angle is commonly employed in perspective. In this book all four angles are used. The problems therefore become general and a large variety of constructions can be introduced under each problem. By inserting the problems for construction in a separate volume and by having several modifications under each problem, work can be read-

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ily assigned to members of a class in recitation; no two students need be given the same work. A large number of carefully arranged problems and some practical applications are given.

A Plan for the Study of Man. With reference to Bills to Establish a Laboratory for the Study of the Criminal, Pauper, and Defective Classes. With a Bibliography of Child Study. By Arthur MacDonald. Washington: Government Printing Office. 1902. Pp. 157.

It is difficult to say what Mr. MacDonald has accomplished in this book. He has collected a mass of information which is apparently not applied to any practical purpose. The pamphlet before us outlines the methods which are to be pursued in a laboratory which Mr. MacDonald would like to establish. The only thing for which we have to be thankful in the publication of this book at the government's expense, is a very good bibliography of child study.

Curvilinear Motion. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 14.

Machines. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 14.

The Kindling Point. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 14.

A Stroke of Lightning. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 16.

Inertia. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 14.

Weight. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. 1902. Pp. 16.

The Molecule. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 13.

Energy: A Constant Quantity. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. 1901. Pp. 15.

The Air. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio. O. T. Corson. 1901. Pp. 15.

A Bent Ray of Light. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 15.

Hot Ice. A Supplementary Reading in Physics. Prepared by J. A. Culler. Columbus, Ohio: O. T. Corson. Pp. 14.

These are excellent little pamphlets describing the principles of physics in a way that is clear and easily understood as well as thoroughly scientific.

The Induction Motor. Its Theory and Design. Set Forth by a Practical Method of Calculation by Henri Boy de la Tour. Translated from the French by C. O. Mailloux, M.A.I.E.E., M.I.E.E. New York: McGraw Publishing Company. 1903. 8vo. Pp. xxvii, 200. Price $2.50.

To American electricians this should be a welcome book, for it can hardly be denied that the induction motor has found its greatest development in Europe. Mr. de la Tour presents a complete study of the polyphase induction motor, and explains at length all the peculiarities of its operation without resorting to more than elementary mathematics. The reader will find a few new deductions and formulæ, such as, for instance, those which enable one to estimate the magnetizing action of wave windings and those for determining the dimensions of the short-circuiting rings for rotors of the squirrel-cage type. Not the least valuable features of the book are the practical examples showing the material effect of the thickness of the air-gap on the value of the magnetic leakage factor.

Cosmetics. A Handbook of the Manufacture, Employment, and Testing of All Cosmetic Materials and Cosmetic Specialties. By Dr. Theodor Koller. Translated from the German by Charles Salter. London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1902. Pp. vii., 262. Price $2.50.

It has been the author's purpose to establish cosmetic technology on a rational basis. Since the cosmetic industry is mainly indebted to the researches of chemists for the advance it has made, it follows, as a matter of course, that the author has drawn upon their work largely for the information he has presented. The author has endeavored to give his reader an accurate knowledge of the materials of which cosmetics are to be made, as well as to point out the best and simplest methods of procedure.

Richerche d'Aeronautica. Estratto dalla publicazione in corso di stampa *Il volo mecanico* per A. Bertelli.

Yucceae. By William Trelease, from the Thirteenth Annual Report of the Missouri Botanical Garden. With 99 plates. 8vo. Pp. 133.

Smithsonian Physical Tables. Second Revised Edition. Prepared by Thomas Gray. Washington: Published by the Smithsonian Institution. 1903. 8vo. Pp. 301.

Geological and Agricultural Report on the Geology of Louisiana. Containing Special Papers by Different Authors Based on the Work of Three Field Seasons, 1900, 1901, and 1902. Gilbert D. Harris, Geologist in Charge; Arthur C. Veatch, Asst. Geologist, and Jov. A. A. Pacheco, Asst. Geologist. Made under the direction of the State Experiment Station, William C. Stubbs, Director. 1902. Baton Rouge, La. 8vo. Pp. 288.

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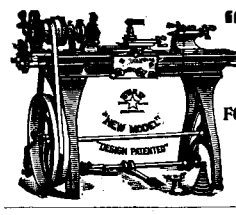

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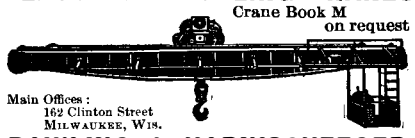

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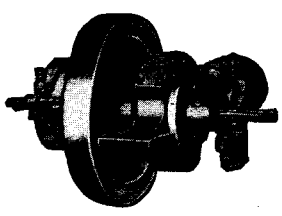

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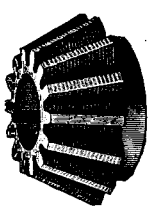

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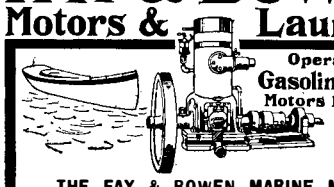

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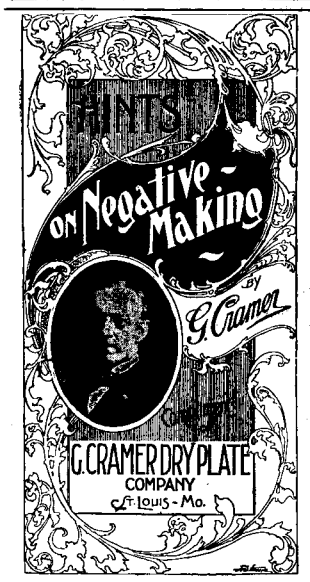

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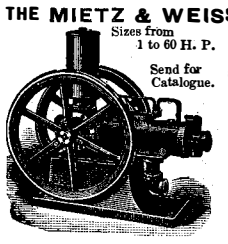

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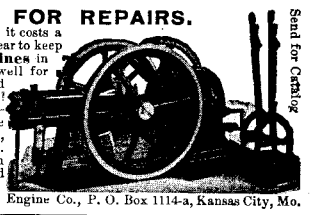

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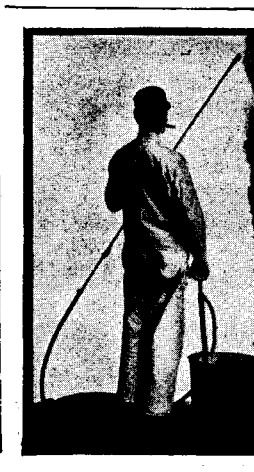

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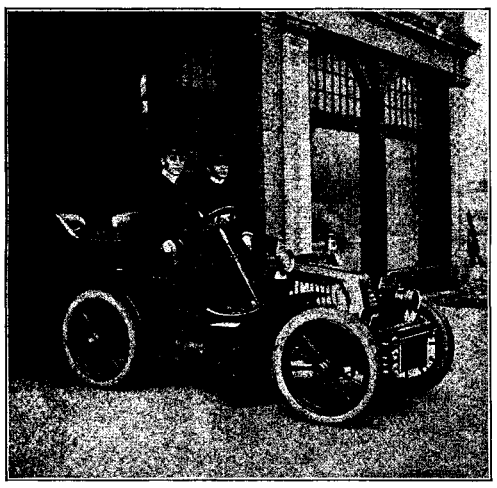

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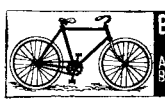

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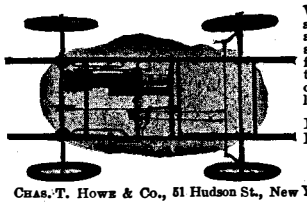

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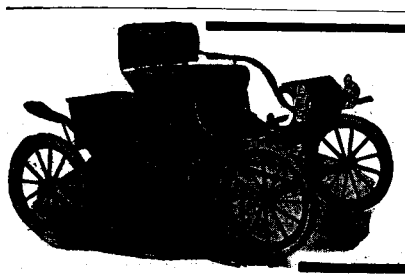

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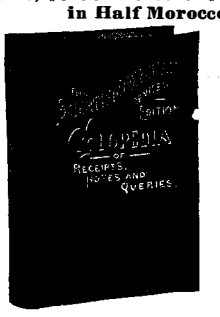

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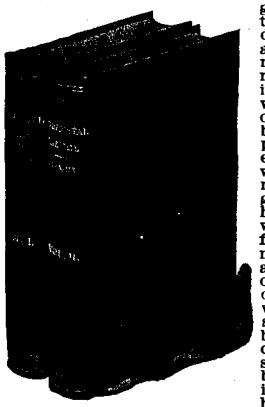

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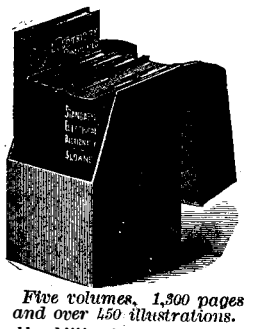

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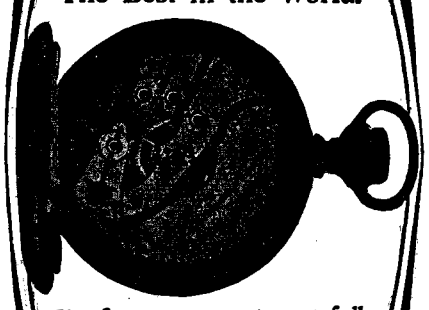

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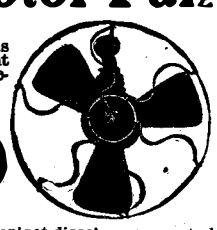

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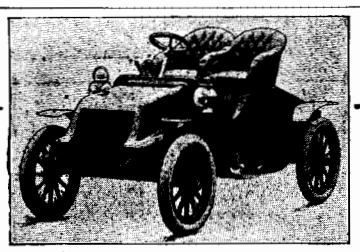

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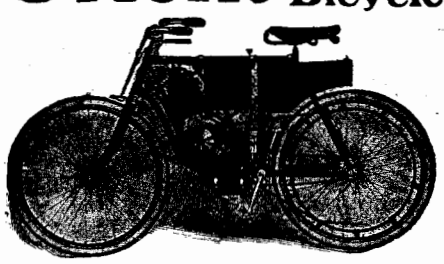

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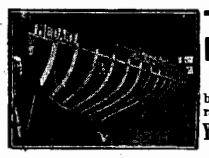

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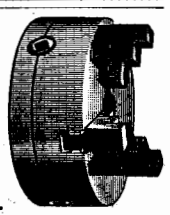

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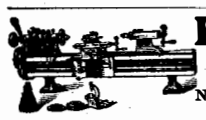

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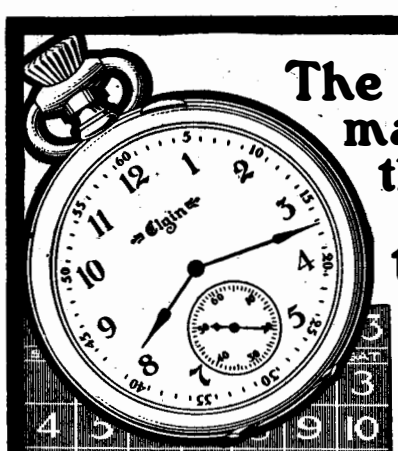

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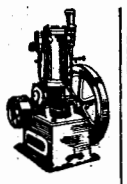

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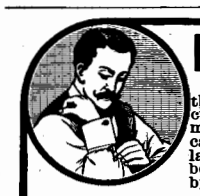

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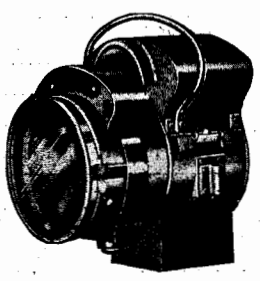

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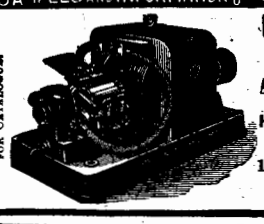

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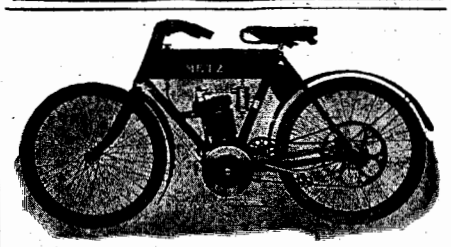

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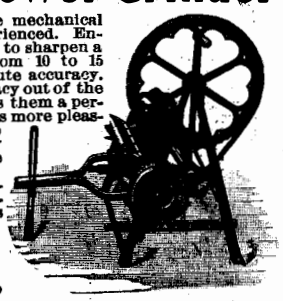

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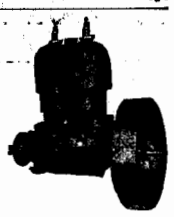

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